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Invasive Plant Management Final Environmental Impact Statement for the Medicine Bow - Routt National Forests and Thunder Basin National Grassland

Garfield, Grand, Jackson, Moffat, Rio Blanco, and Routt Counties, Colorado
Albany, Campbell, Carbon, Converse, Natrona, and Platte Counties, Wyoming

Cheatgrass infestation on the Medicine Bow-Routt National Forest

Invasive Plant Management
Final Environmental Impact Statement
for the
Medicine Bow - Routt National Forests
and Thunder Basin National Grassland

Garfield, Grand, Jackson, Moffat, Rio Blanco, and Routt Counties, Colorado,
Albany, Campbell, Carbon, Converse, Natrona, and Platte Counties, Wyoming

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Abstract: The Medicine Bow - Routt National Forests and Thunder Basin National Grassland evaluated four alternatives for treating invasive plant species. Alternative 1 is a continuation of current invasive species management. Alternative 2, the preferred alternative, would treat several thousand acres annually using combination of manual treatments, mechanical treatments, biological treatments, cultural treatments, and aerial and ground herbicide applications. Alternative 3 is similar to alternative 2 but does not utilize aerial herbicide application. Alternative 4 uses only mechanical, biological, manual, or cultural treatments; no herbicides would be used. Alternative 4 does not meet the purpose and need for the project, but it was analyzed in detail and included as a point of comparison. The proposed treatments would occur over the next 15 years and would utilize adaptive and integrated invasive plant treatment.

Although this project was originally scoped under the provisions of 36 CFR 215 (notice, comment, and appeal procedures for national forest system projects and activities), it is now subject to the provisions of 36 CFR 218 (project-level pre-decisional administrative review process). Individuals or organizations who submitted written comments in response to scoping conducted under 36 CFR 215 will have standing to object under 36 CFR 218, Subparts A and B. Individuals or organizations that did not provide written comments during scoping must have provided specific written comments (as defined in 36 CFR 218.2) on the draft EIS in order to have standing to object.

Objections on the final environmental impact statement and draft record of decision will be accepted for 45 calendar days after publication of the legal notice in the Laramie Boomerang. Publication is expected on May 21, 2015. Objections must meet content requirements of 36 CFR 218.8(d), including objector's name and address, signature or verification of authorship, identification of the project , and a description of those aspects of the project addressed by the objection, including specific issues, suggested remedies, and supporting reasons for the reviewing officer to consider.

Send objections to: USDA Forest Service, Region 2 Rocky Mountain Region
Attn.: Objection Reviewing Officer
740 Simms Street
Golden, CO 80401-4720

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Summary

The Medicine Bow - Routt National Forests and Thunder Basin National Grassland (MBRTB) propose to treat invasive plant species using an adaptive and integrated invasive plant treatment strategy. The preferred alternative (alternative 2) would be implemented over the next 15 years and would treat several thousand acres annually using a combination of manual treatments, mechanical treatments, biological treatments, cultural treatments,[1] and aerial and ground herbicide applications. Potential treatment areas include crucial big game winter ranges and other important habitats, fuels reduction projects, roads and trails, power lines, areas of timber harvest, and beetle-killed forests where invasive plant species have already begun to proliferate. Implementing the preferred alternative would require compliance with herbicide label restrictions and comprehensive resource protection measures.

The preferred alternative would broaden the current management (noxious weed prevention, education, and treatment of existing weed infestations) to do the following:

- Treat infestations through adaptive management tools for assessing new treatments and new sites.
- Treat invasive species in addition to those listed as noxious farm weeds by the states of Colorado and Wyoming.
- Allow the use of newly developed, more species-specific, EPA-registered herbicides. A Forest Service assessment team would be established to review the EPA-issued registration eligibility decision and determine the new herbicide’s appropriateness for use on public lands.
- Broaden control methods to include the use of aerial application of herbicides in limited or specific circumstance; for example, large infestations of weeds especially those in inaccessible or remote areas and infestations in areas of critical habitat where ground application cannot be done safely or effectively.
- Broaden protection measures for ground and aerial applications of herbicides.

The areas affected by the project are the Medicine Bow National Forest, the Routt National Forest, and the Thunder Basin National Grassland. The Medicine Bow National Forest includes 1,095,386 acres of national forest system (NFS) land in five Wyoming counties: Albany, Carbon, Converse, Natrona, and Platte. The Routt National Forest is located in northwestern Colorado occupying 1,125,568 acres of NFS land in Garfield, Grand, Jackson, Moffat, Rio Blanco, and Routt counties. The Thunder Basin National Grassland is located in northeastern Wyoming and occupies about 553,300 acres of NFS land among a mosaic of state, federal, and private lands in Campbell, Converse, Crook, Niobrara, and Weston counties.

New direction for invasive plant management on the MBRTB is needed for the following reasons:

- To meet existing law, regulation, and agency policy directing the Forest Service to treat non-native and invasive plants.
- To update existing management direction to include new invasive species and new treatments.
- To make cooperative treatment and control of invasive plant species more consistent and effective across land ownership boundaries. Without an adequate plan for lands managed by the MBRTB, invasive species control efforts on adjacent lands under other federal, state, and private ownership may not be effective.
- To help meet or maintain desired resource conditions on the MBRTB. Invasive plants are threatening or dominating areas of both forests and the grassland with resulting impacts to native plant communities, soil, watershed function, wildlife habitats, forage areas for wildlife and livestock, and recreational and scenic values.

[1] Examples of cultural treatments are seeding native plants, grazing, and use of fertilizer.

The project was first listed in the forestwide schedule of proposed actions (SOPA) for the Medicine Bow-Routt National Forest in October 2009. The scope of the project was expanded and the notice of intent (NOI) was published in the Federal Register on December 1, 2010 which started a 45-day comment period. The agency sent out over 500 scoping letters to individuals, businesses, organizations, and tribes and received comments from 24 respondents (members of the public and other local, state, and federal agencies).

Using the information from scoping comments, the agency developed three alternatives to the proposed action (alternative 2). Effects of implementing the proposed action and alternatives were analyzed and disclosed in the draft environmental impact statement (DEIS). The analysis focused on the issues (identified during public scoping) and resource concerns (identified by the MBRTB) listed below. The order in which the issues and resource concerns are listed is arbitrary; it does not imply priority or importance.

- Issue #1: Effects on native vegetation, biological diversity, production, and structure.
- Issue #2: Effects of herbicides on threatened, endangered, or sensitive species and their habitats.
- Issue #3: Effects of herbicides on soils, water, and aquatic resources.
- Issue #4: Effects of herbicides on human health.
- Effects on wilderness, recommended wilderness, inventoried roadless areas, wild and scenic rivers, and research natural areas.
- Effects on recreation users.
- Effects on social and economic considerations, including effects on partnerships/cooperators.

The DEIS was released on March 21, 2014 which started the 45-day comment period. The comment period ended on May 7, 2014. We received comments from sixteen individuals, agencies, and organizations. Appendix E lists the comments and the agency responses.

Based upon the effects of the alternatives, the responsible official will make the following decisions:

- Whether to expand current efforts to control invasive plants.
- What control methods would be used.
- What herbicides would be used.
- What protection measures and monitoring measures would be required.
- Whether to include an adaptive management approach to address future spread of invasive weeds.

Figure 1. Vicinity map of the Medicine Bow-Routt National Forests and Thunder Basin National Grassland.

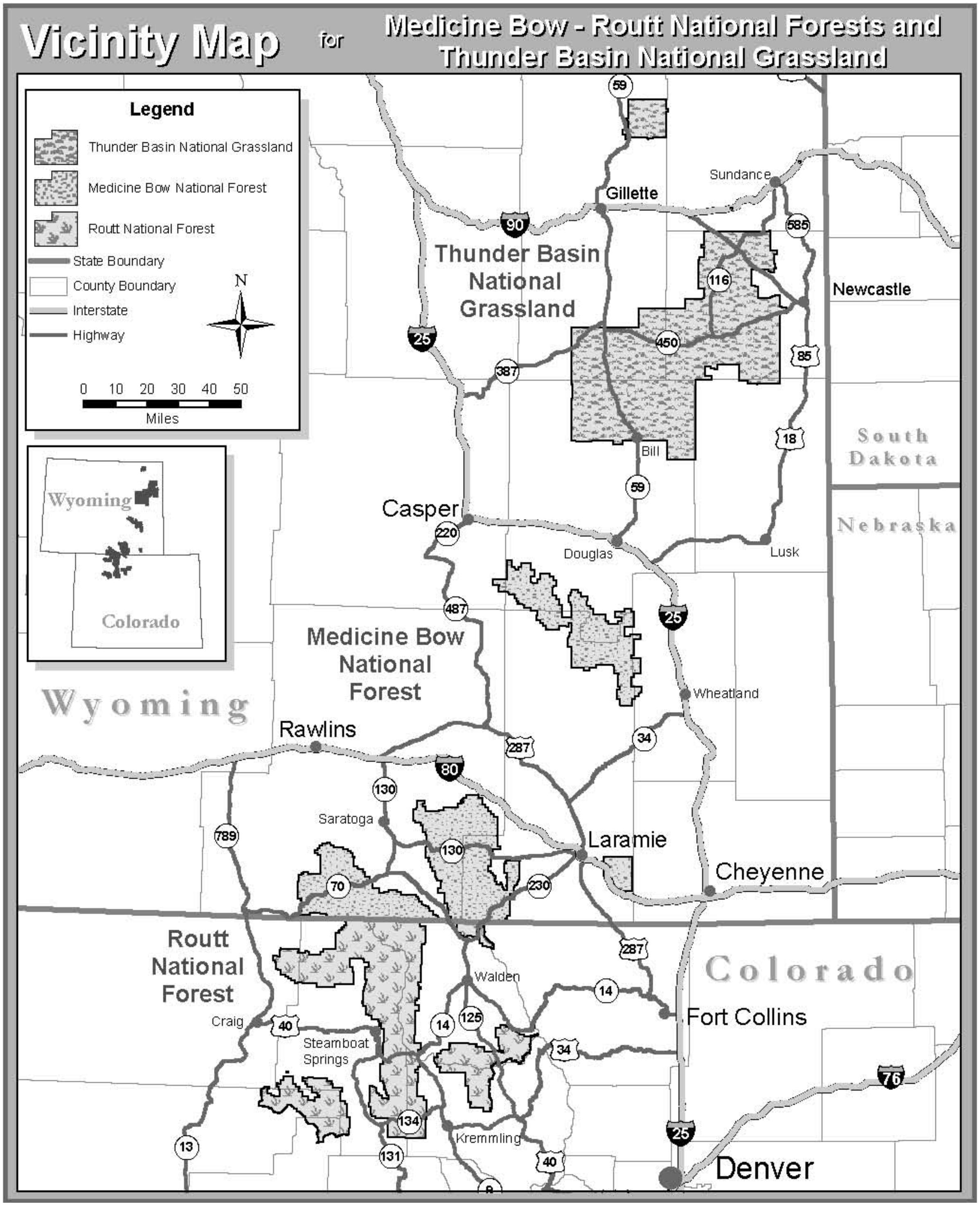


Table 1. Changes between draft and final.

Location in document	**Change**
Abstract, chapter 2	Added discussion about alternative 4 not being a viable alternative.
Chapter 2, alternatives 2 and 4, integrated pest management options	Clarified the use of livestock grazing as a treatment option for invasive plants. Clarified the biological control options available.
Chapter 2, *Alternatives Considered* section	Updated forest plan consistency discussion based on additional IDT analysis and professional review. Added an alternative considered but not analyzed in detail – a proposed 8,020-acre herbicide exclusion zone.
Chapter 2, *Comparison of Alternatives* section, table 4	Added effects to sensitive subgroups to the comparison table.
Chapter 3, *Human Health* section	Added discussion about effects to sensitive subgroups.
Chapter 3, effects to Ute ladies'-tresses	Corrected the determination for Ute ladies'-tresses under alternative 4 to "may affect, not likely to adversely affect". It was incorrect in the DEIS.
Chapter 3, *Soil, Water, and Aquatic Resources* section	Added discussion about lineage greenback cutthroat trout. It was inadvertently ommitted from the DEIS.
Chapter 3, *Wildlife Resources* section, environmental effects dicsussion	Added discussion about Rocky Mountain bighorn sheep and targeted grazing with sheep and goats.
Chapter 3, forest plan consistency discussions	Updated the forest plan consistency discussions in the following sections based on additional IDT analysis and professional review: native vegetation and invasive species; soil, water, and aquatic species; wilderness, recommended wilderness and eligible wild and scenic rivers; special interest areas and research natural areas, and social and economic aspects.

Chapter 1. Purpose of and Need for Invasive Plant Management on the MBRTB

The Forest Service has prepared this final environmental impact statement (FEIS) in compliance with regulations defined by the Council of Environmental Quality (CEQ) for implementing provisions of the National Environmental Policy Act of 1969 (NEPA) as amended, (40 CFR 1500-1508); U.S. Forest Service Environmental Policy and Procedures Handbook (FSH 1909.15); U.S. Forest Service Pesticide Use Management Handbook (FSH 2109.14); U.S. Forest Service Manual Invasive Species Management (FSM 2900), U.S. Forest Service Manual Environmental Management (FSM 2100) Chapter 2150 Pesticide-Use Management and Coordination (2013); Executive Order 13112 (1999); and other public land laws, rules, and regulations.

The FEIS discloses the direct, indirect, and cumulative environmental effects that would result from implementing the four alternatives for invasive plant treatment on the Medicine Bow-Routt National Forests and Thunder Basin National Grassland (MBRTB). Additional documentation, including detailed analyses of the project, is maintained with the project record at the supervisor's office for the Medicine Bow – Routt National Forests and Thunder Basin National Grassland in Laramie, Wyoming.

Background

Nationally, non-native invasive plants are a growing environmental concern. The MBRTB recognizes that without efforts to control non-native invasive plants, their populations will expand, affecting the health, and influencing the use, of habitats across the two forests and the grassland. In 2003, Forest Service Chief Dale Bosworth identified non-native and invasive species as one of four major threats compromising the Forest Service's ability to protect and restore the Nation's forests and grasslands. The ecological and economic effects of invasive species can be substantial and may include increasing environmental susceptibility to, and severity of, wildland fires.

The current MBRTB 1996 *Management of Noxious Weeds Environmental Assessment* and subsequent NEPA decisions for noxious weeds contain direction for control or containment of noxious and other undesirable weeds using an integrated pest management strategy. However, these decisions did not analyze control of a comprehensive list of non-native invasive plant species already occurring on the MBRTB or likely to arrive within the next 10 years, effects of new herbicides, or the aerial application of herbicides.

Integrated pest management strategies utilize various treatment options that identify the most economical and effective control of non-native and invasive plants. Anything that weakens the plant, prevents spreading, or prevents seed production can be an appropriate management tool. This analysis assesses the forestwide effects of new and existing treatment options and includes treatment of new non-native and invasive plant species. Proposed methods to control non-native and invasive plants include a combination of , mechanical treatments, biological treatments, cultural[2] weed treatments, and ground and aerial application of herbicides.

[2] Examples of cultural control are seeding native plants, grazing, use of fertilizer.

To maintain consistency in this analysis, the following definitions are used to describe undesirable plants on the MBRTB. The terms non-native invasive plants, invasive plants, and invasive species will be used interchangeably.

- Non-native plants - In most cases, these are introduced species, plants that are not native to the region in which they occur.
- Noxious weed - A plant species that is highly injurious or destructive and has the greatest potential for economic impact on forage and crop production. *Designated noxious weeds* are weeds that are designated state-wide. *Declared noxious weeds* are those that have been declared on a county-by-county basis.
- Invasive plants - All state- and county-listed noxious weeds are considered invasive plants. Also included in this designation are non-native plants that can successfully outcompete native plants and displace native plant communities but are not listed by state or counties as noxious weeds.

Purpose of and Need for Invasive Plant Management on the MBRTB

New direction for invasive plant management on the MBRTB is needed for the following reasons. Each item is discussed in greater detail in the sections below.

- To meet existing law, regulation, and agency policy directing the Forest Service to treat non-native and invasive plants.
- To update existing management direction to include new invasive species and new treatments.
- To make cooperative treatment and control of invasive plant species more consistent and effective across land ownership boundaries.
- To help meet or maintain desired resource conditions on the MBRTB, including limiting the spread of invasive plants into areas with little or no infestation to help reduce fire hazard and/or risk.

Meeting existing law, regulation, and agency policy for treating non-native and invasive plants

The Forest Service is directed by law, regulation, and agency policy to treat non-native and invasive plants. Several laws and regulations specifically address control of such species.

- *Carlson-Foley Act of 1968* (PL 90-583) authorizes and directs federal agencies to permit control of noxious weeds on federal lands by state and local governments on a reimbursement basis in connection with similar weed control programs carried out on adjacent nonfederal land.
- *Federal Noxious Weed Act of 1974* (PL 93-629) defines weeds, and authorizes the Secretary of Agriculture to cooperate with other agencies, organizations, or individuals to control and prevent noxious weeds.
- *The Federal Land Policy Management Act of 1976* (PL 94-579) authorizes control of weeds on rangeland.
- *The National Forest Management Act of 1976* (PL-94-588) authorizes removal of deleterious plant growth through forest plans.
- *The Wilderness Act of 1964, as amended (October, 1978).* The management goal for wilderness areas is to retain their primitive character and influence, without permanent improvements or human habitation, so as to preserve natural condition.

- *U.S. Forest Service Pesticide Use Management and Coordination Handbook* (FSH 2109.14) provides Forest Service personnel with direction for proper use of, and containment and safety procedures for, pesticides.
- *FSM 2100, Chapter 2150. Pesticide-Use Management and Coordination* directs the Forest Service to plan, evaluate, and review pesticides and their use, as well as provide for safety in pesticide use, storage, transportation, and disposal.
- *FSM 2900, Invasive Species Management* lists laws and regulations for the Forest Service to adhere to. Additionally, the manual states that the Forest Service invasive species policy and management objectives will be based on integrated pest management.
- *Code of Federal Regulations, 36 CFR 222.8* directs the Forest Service to cooperate with local weed control districts to analyze and develop noxious weed control programs where there are national forests and grasslands.
- *Forest Service Manual 2259.03* states, "Forest officers shall cooperate fully with State, County and Federal officials in implementing 36 CFR 222.8 and Sections 1 and 2 of Public Law 90-583. Within budgetary constraints, the Forest Service shall control to the extent practical, noxious farm weeds on all NFS lands."
- *Colorado Noxious Weed Act of 1996* (C.R.C. Title 35-5.5) declares that undesirable plants that constitute a threat must be managed regardless of land ownership.
- *Wyoming Weed and Pest Control Act of 1973* (W.S. 11-5-101-11-5-119), the purpose of which is to control designated weeds and pests regardless of land ownership.
- *Wyoming Weed and Pest Special Management Program* (W.S. 11-5-301-11-5-303) authorizes development of county weed and pest control districts and an integrated management system for planning and implementation of a coordinated program utilizing all proven methods of control.
- *1996 MBRTB Management of Noxious Weeds Environmental Assessment* describes control of weeds on the MBRTB by setting priorities, developing a prevention plan, continuing weed inventory, and implementing a noxious weed control program.
- *Executive Order 13112 Invasive Species* (64 FR 6183; February 8, 1999) directs federal agencies "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause."

Direction and support for non-native and invasive plant species management is also provided in the following:

- The 1998 *Forest Service Natural Resource Agenda* placed a strong emphasis on conserving and restoring degraded ecosystems as a management priority for the 21st Century, including actions to "attain desirable plant communities and prevent exotic organisms from entering or spreading in the United States."
- The 1998 *Forest Service Strategy for Noxious and Non-native Invasive Plant Management* provided a "roadmap into the future for preventing and controlling the spread of noxious weeds and non-native invasive plants."
- *The 2004 National Strategy and Implementation Plan for Invasive Species Management* identified the Forest Service as one of the lead agencies in the effort to control non-native and invasive plants. It provides long-term direction to reduce, minimize, or eliminate invasive species across all landscapes and ownerships by improving the management of invasive species using science-based technology, by emphasizing partnerships, and by increasing performance and accountability, as well as communication and education.

Updating existing management direction to include new invasive species and new treatments

The 1996 and 2000 management direction for noxious weeds on the MBRTB did not anticipate the rate at which non-native and invasive plants have spread. There is a need to update that management direction to address new invasive plant species and new treatment options. This project provides the opportunity to update the 1996 *Noxious Weed Management Environmental Assessment* and the 2000 *Noxious Weed Implementation Plan* by broadening the present adaptive and integrated management approach to include the following:

- Treatment of additional non-native and invasive species. At present, the MBRTB only has authorization to treat plant species classified as noxious farm weeds by Colorado or Wyoming. Cheatgrass is not classified as a noxious farm weed in Wyoming, and there are other highly invasive species that should be treated whether or not they have been added to state lists of noxious weeds.
- Use of new herbicides that were developed and received EPA approval after 1996 or that may be developed in the future. A Forest Service assessment team will be established to review the EPA-issued registration eligibility decision and determine the new herbicide's appropriateness for use on public lands.
- Authorization to use aerial application of herbicides in prescribed situations; for example, large infestations of weeds in inaccessible or remote areas and infestations in areas of critical habitat where ground application cannot be done safely or effectively.
- Additional specific protection measures for wildlife and aquatic resources.

The distribution, density, and number of invasive species occurring on MBRTB have increased, in part, due to the following:

- Large infestations occurring on lands adjacent to NFS lands.
- An increase in recreational activities, including use of off-highway vehicles, that have resulted in new infestations or accelerated the rate of spread of current infestations.
- Lack of appropriate treatment options, such as the aerial application of herbicides to treat cheatgrass (*Bromus tectorum*) infestations. As a result, cheatgrass now occurs on more acres than all other invasive plants on the MBRTB combined.
- Extended drought that has allowed cheatgrass to become established and spread rapidly, particularly in prescribed burn units, areas burned by wildfire, and in prairie dog towns.
- A large-scale mountain pine beetle epidemic that has resulted in extensive areas of habitat now susceptible to non-native and invasive plant establishment.
- An increase in commercial uses on the MBRTB and surrounding lands, such as oil and gas development and wind farm construction, that has created environments suitable for the establishment of non-native and invasive species.

Making cooperative treatment and control more consistent and effective

Without an adequate plan for invasive plant species control on the MBRTB, control efforts on adjacent and intermingled lands will be less effective. The public continues to demand increased invasive plant species control efforts on local, state, and federal lands. The MBRTB has multiple cooperative weed management area agreements with counties and is pursuing additional coordinated efforts. Where private land owners and/or other federal, state and county landowners pool resources to treat invasive species, these treatments are less effective if weeds on adjacent or intermingled national forests or national grasslands are not treated because the Forest Service is not able to use some specific herbicides or cannot utilize aerial application. The seed source remains nearby to re-infest the treated sites and the Forest

Service cannot take advantage of the reduced treatment costs that can result from large scale treatment projects and leveraging of grant money.

Recreation and other vehicle traffic, wildlife, livestock, wind, and contaminated gravel, straw, and hay readily move invasive plants between the MBRTB and other lands. Many adjacent landowners control noxious weeds on their property. Consequently, a partnership approach among adjoining federal and state agencies, local governments, and owners of adjacent and intermingled private land is vital to a successful treatment and control program.

Meeting or maintaining desired resource conditions on the MBRTB

The preferred alternative responds to the goals and objectives outlined in the three forest and grassland plans and helps move the MBRTB toward the desired conditions described in these plans by doing the following:

- Protecting the natural condition and biodiversity of the MBRTB by preventing or limiting the spread of non-native and invasive plant species.
- Promptly eliminating newly identified populations of invasive species not previously reported on NFS lands before they become firmly established.
- Preventing or limiting the spread of established invasive plants into areas containing little or no infestation. This could also reduce fire hazard and risk.
- Protecting sensitive and unique habitats including critical big game winter ranges and other important habitats.
- Reducing known and potential invasive plant seed sources along roads and trails and within powerline corridors, fuels reduction projects, areas of timber harvest, and beetle-killed forests where invasive plant species have already begun to proliferate.

Invasive plants are threatening or dominating forests and grassland areas, with resulting impacts to native plant communities, soil, watershed function, wildlife habitats, forage areas for wildlife and livestock, and recreational and scenic values. Non-native and invasive plants currently infest more than 175,000 acres (6%) of the MBRTB. Density of infestations varies from a few plants per acre to nearly solid monocultures of non-native and invasive species.

Non-native plants on the MBRTB have invaded important big game winter ranges, reducing forage available for over-wintering mule deer, elk, moose, and bighorn sheep. On the Thunder Basin National Grassland, cheatgrass invasion into big sagebrush (*Artemisia tridentata*) stands has degraded habitat for sagebrush-dependent species such as the greater sage-grouse (*Centrocercus urophasianus*). Once cheatgrass dominates the spaces between sagebrush plants, the likelihood of wildfire, and the severity of wildfire, is increased. Wildfires supported by fine fuels such as cheatgrass may kill big sagebrush, thereby degrading or reducing habitat for sage-dependent species.

Preferred Alternative (Alternative 2)

The Forest Service proposes to treat invasive plant species on the MBRTB using an adaptive and integrated invasive plant treatment strategy. The preferred alternative would occur over the next 15 years and would treat several thousand acres annually using combination of manual treatments, mechanical treatments, biological treatments, cultural treatments, and aerial and ground herbicide applications. Potential treatment areas include crucial big game winter ranges and other important habitats, fuels reduction projects, roads and trails, power lines, areas of timber harvest, and beetle-killed forests where invasive plant species have already begun to proliferate. Implementing the preferred alternative would require compliance with herbicide label restrictions and comprehensive resource protection measures. The preferred alternative is described in more detail in chapter 2.

Current management of invasive plant species is based on the 1996 MBRTB *Management of Noxious Weeds Environmental Assessment* and includes prevention and treatment of, and education about, existing noxious weed infestations. The preferred alternative would broaden the current management to:

- Treat infestations through adaptive management tools for assessing new treatments and new sites.
- Treat invasive species in addition to those listed as noxious farm weeds by the states of Colorado and Wyoming.
- Allow the use of newly developed, more species-specific, EPA-registered herbicides. A Forest Service assessment team would be established to review EPA's registration eligibility decision and determine the new herbicide's appropriateness for use on public lands.
- Broaden control methods to include the use of aerial application of herbicides in limited or specific circumstance; for example, large infestations of weeds in inaccessible or remote areas and infestations in areas of critical habitat where ground application cannot be done safely or effectively.
- Broaden protection measures for ground and aerial applications of herbicides.

Recent efforts have treated 2,000-3,000 acres annually. Aerial treatments are necessary for safe, uniform, effective herbicide application on steeper slopes (for example, areas of critical big game winter range) and to treat infestations that are negatively affecting native plant populations, especially those in critical sage-grouse habitat. Aerial herbicide application is the only practical means of treating the extensive infestations of cheatgrass on the Thunder Basin National Grassland. It would allow us to treat an estimated additional 1,000 to 5,000 acres in cooperation with state, county, and other partners. The preferred alternative is consistent with forest and grassland plan direction and desired conditions for native plant communities and weed species management.

Decision Framework

The deciding official reviews the purpose and need, the preferred alternative and other alternatives, and the environmental effects in order to make the following decisions:

- Whether to expand current efforts to control invasive plants and noxious weeds.
- What control methods would be used.
- What herbicides would be used.
- What protection measures and monitoring measures would be required.
- Whether to include an adaptive management approach to address future spread of invasive plants and weeds.

The FEIS is a landscape-scale analysis. The scope of the project is confined to issues and potential environmental consequences relevant to the decision. This analysis does not attempt to re-evaluate or alter decisions made at higher levels. The decision is subject to, and would implement, direction from higher levels.

National and regional policies and forest plan direction require consideration of effects of all projects on weed spread and prescribe protection measures, where practical, to limit those effects. Reconsidering other project level decisions or prescribing protection measures or standards for future forest management activities (such as travel management, timber harvest, and grazing management) is beyond the scope of this document. Chapter 3 contains cumulative effects analyses which evaluate the effects of the preferred alternative in combination with effects of other forest activities.

The following decisions will **not** be made based on analyses done for this project:

- Changes in land use and forest management objectives.
- Changes in the level of wildland fire suppression, strategies, tactics, and decisions on whether or not to control wildfire.
- Re-evaluation of road analyses or road management decisions, including changes in travel, road use, and access.
- Existing prevention measures that minimize establishment and spread of noxious weeds are already a part of Forest Service policy, and recent decisions will not be repeated in this analysis.

Public Involvement

The project was listed in the forestwide schedule of proposed actions (SOPA) for the Medicine Bow-Routt National Forest in October 2009. The notice of intent (NOI) was published in the Federal Register on December 1, 2010 which started a 45-day comment period. The agency sent out over 500 scoping letters to individuals, businesses, organizations, and tribes that have expressed an interest in the project development process. Written comments were received from twenty-four respondents: members of the public, local and state agencies, and other federal agencies. The interdisciplinary team used the comments to develop a list of issues to be addressed.

Using the information gleaned from scoping comments, the agency developed three alternatives to the proposed action (alternative 2). Effects of implementing the proposed action and alternatives were analyzed and disclosed in the DEIS. The analysis focused on the following issues (identified during public scoping) and resource concerns (identified by the MBRTB):

- Issue #1: Effects on native vegetation, biological diversity, production, and structure.
- Issue #2: Effects of herbicides on threatened, endangered, or sensitive species and their habitats.
- Issue #3: Effects of herbicides on soils, water, and aquatic resources.
- Issue #4: Effects of herbicides on human health.
- Effects on wilderness, recommended wilderness, inventoried roadless areas, wild and scenic rivers, and research natural areas.
- Effects on recreation users.
- Effects on social and economic considerations, including effects on partnerships/cooperators.

The DEIS was released on March 21, 2014 which started the 45-day comment period. The comment period ended on May 7, 2014. We received comments from sixteen individuals, agencies, and organizations. Appendix E lists the comments and the agency responses.

Chapter 2. Alternatives

Introduction

This chapter provides a more detailed description of the agency's preferred alternative (alternative 2) for invasive plant management on the MBRTB and three alternative management scenarios. The alternatives were created using scoping comments submitted by the public and internal Forest Service input. This chapter includes discussion on integrated and adaptive management and a summary table comparing the alternatives.

Alternatives Considered in Detail

The Forest Service developed four alternatives that are considered in detail in this EIS.

- Alternative 1, no action – no change from current management.
- Alternative 2, the preferred alternative. Aerial and ground-based herbicide applications plus manual, mechanical, biological, and cultural control and combinations of treatments.
- Alternative 3, no aerial herbicide application. Ground-based herbicide application plus manual, mechanical, biological, and cultural control and combinations of treatments.
- Alternative 4, no herbicide application. Manual, mechanical, biological, and cultural control and combinations of those treatments. This alternative does not meet the purpose and need of the project: treating new invasive species and using new treatments, making cooperative treatment and control of invasive plant species more consistent and effective across land ownership boundaries, meeting or maintaining desired resource conditions on the MBRTB, including limiting the spread of invasive plants. However, it was included in the analysis as a point of comparison.

The preferred alternative (alternative 2) and alternatives 1, 3, and 4 were reviewed for consistency in meeting standards and guidelines in the following forest and grassland plans:

- *Medicine Bow National Forest Revised Land and Resource Management Plan, December 2003* -
- *Routt National Forest Land and Resource Management Plan, February 1998*
- *Thunder Basin National Grassland Land and Resource Management Plan* - *Northern Great Plains Management Plans Revision, July 2002*

Alternatives 1, 2, and 3 are consistent with forest and grasslands standards and guidelines. Alternative 4 is not consistent with the following guidelines in the *Thunder Basin National Grassland Land and Resource Management Plan* - *Northern Great Plains Management Plans Revision, July 2002*; it does not include all available treatment methods.

J. Noxious Weeds, Non-native, and Invasive Species

1. Manage invasive plant species using integrated management techniques, including mechanical, chemical, and biological control methods. Guideline

6. Utilize all methods feasible, including livestock grazing strategies in the integrated pest management program. Guideline

Features Common to all Alternatives

Integrated and adaptive weed management

Integrated and adaptive weed management strategies would be used under all alternatives, but the specific tools available for weed treatment and the adaptability vary by alternative. Integrated management uses a variety of weed prevention and weed treatment methods to maximize effectiveness while minimizing negative effects to other resources.

In adaptive management, our management strategy changes over time as weed treatment challenges and opportunities change. Two examples of adaptive management are use of a newly approved herbicide that is more selective or treatment of a new invasive plant species which has not been encountered before. The integrated and adaptive management strategies for each alternative are discussed in the following sections.

Resource protection measures

Protection measures are described in appendix A. The alternatives have some protection measures in common, but some protection measures only apply to particular alternatives. For example, protection measures for aerial application of herbicides only apply to the preferred alternative (alternative 2).

Resource protection measures are actions designed into the alternatives to reduce impacts of proposed activities. They include requirements that must be complied with by law, regulation, or policy; best management practices (BMPs); forest and grassland plan standards and guidelines; and standard operating procedures.

Cooperation and coordination

To increase the effectiveness of invasive plant treatments, the MBRTB would continue cooperative, multi-ownership control efforts and would expand those efforts where possible. Cooperative efforts may include any of the following:

- Sharing databases and information on the presence of weeds.
- Sharing resources such as personnel, equipment, and chemicals. This would include working with counties to prioritize roads for weed treatments and developing funding agreements for weed control work along priority roads crossing MBRTB and county lands.
- Using input from the counties and local land owners to help set treatment priorities.
- Applying for and sharing grants and aid as a block of cooperators instead of single agencies or organizations.
- Using cooperative agreements to pay for weed control work that crosses ownership boundaries.

Monitoring and record keeping

Under all four alternatives, invasive plant species treatments would be recorded, monitored, and reported annually. Detailed, accurate record keeping and monitoring are fundamental components of a successful adaptive management program. Record keeping provides a historical record of activities and helps map future treatment activities. Monitoring and surveying are necessary to determine whether treatments are effective and meeting management objectives.

Annual reporting is important and required for program accountability. It includes inventorying invasive plant species treated and documenting specifics of each treatment. Global Positioning System (GPS) devices or other methods are used to map the treated area and record specific site data. Those data may include the following:

- Name of invasive plant targeted for treatment.
- Treatment method.
- Date and time of treatment.
- Name, location, and estimated area of treatment site.
- Biocontrol – species and number of biological control agents released.
- Herbicide – brand name and EPA registration number, formulation, mix rate, amount applied, applicator's name, and general weather conditions, including wind speed.

Alternative 1 – No Action (No Change from Current Management)

Under the no action alternative, the current weed management program would continue. Herbicides would only be applied using ground-based methods; aerial application would not be used.

Eleven of the 17 herbicides identified in the 1996 MBRTB *Noxious Weed Management Environmental Assessment* would be available for routine weed control: chlorsulfuron, clopyralid, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr and 2,4-D. Six herbicides have not been used in the past, and they would not be used under this alternative: atrazine, bromacil, diuron, tebuthiuron, simazine, and mefluidide.

Adaptive management strategies would include the treatment of any newly introduced invasive plant species that are classified as noxious farm weeds by the states of Wyoming or Colorado, treatment of weed infestations in new areas, and use of new biological agents as they are approved by the USDA Animal and Plant Health Inspection Service (APHIS).

Integrated pest management – mechanical, cultural, biological, and chemical (herbicide) treatments – would continue. Present weed management techniques are described in chapter 3 in the *Native Vegetation and Invasive Species* section.

Past funding has allowed treatment of approximately 2,000-3,000 acres annually. Many of these acres are re-treatment acres since some infestations require repeated treatment for 5 to 8 years to ensure effective control or provide containment.

Appendix A lists protection measures for the no action alternative.

Alternative 2 – The Preferred Alternative

The preferred alternative would expand current management to include:

- Treatment of new invasive species and those listed as noxious farm weeds by the states of Colorado and Wyoming.
- Use of new, more species-specific, EPA-registered herbicides. An MBRTB assessment team would evaluate new herbicides that become available after this analysis. The team would review the EPA's registration eligibility decision for new herbicides and determine if the herbicides are appropriate for use on the forests and grassland.
- Aerial herbicide application.
- Protection measures not included in the present weed management program (the no action alternative). This would include protection measures for ground-based and aerial herbicide application.

Fourteen herbicides would be available for use under alternative 2: aminopyralid, chlorsulfuron, clopyralid, dicamba, fluroxypyr, glyphosate, hexazinone, imazapic, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr, and 2,4-D. All are EPA-registered and have Syracuse Environmental Research Associates (SERA) risk assessments. Aminopyralid, fluroxypyr, and imazapic are not included in the present weed management program (the no action alternative) because they had not been fully tested and approved when the 1996 analysis was done. See appendix B and the risk assessments in the project record for more information on these herbicides.

The following six herbicides would not be available for use under alternative 2: atrazine, bromacil, diuron, tebuthiuron, simazine, and mefluidide. They were not included in the proposed action because they have not been used in the current weed management program and the fourteen proposed herbicides are more effective with less risk.

The preferred alternative would be implemented over the next 15 years and would treat approximately 3,000 and 8,000 acres annually. Of that, an estimated 1,000 to 5,000 acres could be treated using aerial application of herbicides. Aerial treatment would primarily target cheatgrass, and the herbicide initially proposed for use is imazapic. Imazapic is a selective herbicide that is effective on annual grasses.

The following table lists invasive plants known to occur on the MBRTB and those considered likely to occur on the MBRTB in the future. It is not possible to include all future invasive plant species that could eventually occur on the MBRTB.

Priority 1 indicates non-native and invasive species of highest priority for treatment, and eradication if possible, on NFS lands. In areas where known infestations of these non-native and invasive species occur on adjacent non-NFS lands, prevention and monitoring activities will be given highest priority. Efforts will be prioritized to coordinate control efforts across jurisdictions and to cooperate with adjacent landowners to treat these infestations.

Priority 2 indicates non-native and invasive species which are increasing on NFS lands. Efforts here will be to prevent new infestations and to contain or reduce existing infestations. Purple loosestrife is not currently known to exist on the Medicine Bow-Routt National Forests, but its rapid increase on the Colorado Front Range makes the two forests prime candidates for new infestations. Efforts here will be to spot infestations as soon as possible and to work toward eradication if infestations occur.

Priority 3 indicates non-native and invasive species which are so common and widespread that forestwide eradication is not possible. Efforts here will be directed toward prevention of new infestations and control of localized infestations in priority habitats.

Priority 4 indicates non-native and invasive species which are not currently known to occur on NFS lands. Prevention will be the focus for these species.

Table 2. Invasive plant species proposed for treatment and priority of treatment should they occur on the MBRTB.

Common Name	Scientific name	Priority
Dalmatian toadflax	*Linaria dalmatica*	1
Diffuse knapweed	*Centaurea diffusa*	1
Leafy spurge	*Euphorbia esula*	1
Russian knapweed	*Acroptilon repens*	1
Saltcedar	*Tamarix complex*	1
Spotted knapweed	*Centaurea stoebe ssp micranthos*	1
Squarrose knapweed	*Centaurea virgata ssp squarrosa*	1
Yellow toadflax	*Linaria vulgaris*	1
Black henbane	*Hyoscyamus niger*	2
Cheatgrass	*Bromus tectorum*	2
Hoary cress	*Cardaria draba*	2
Musk thistle	*Carduus nutans*	2
Russian olive	*Elaeagnus angustifolia*	2
Common tansy	*Tanacetum vulgare*	2
Scentless chamomile	*Tripleurospermum perforatum*	2
Sulphur cinquefoil	*Potentilla recta*	2
Canada thistle	*Cirsium arvense*	3
Field bindweed	*Convolvulus arvensis*	3
Houndstongue	*Cynoglossum officinale*	3
Ox-eye-daisy	*Leucanthemum vulgare*	3
Common mullein	*Verbascum thapsus*	3
Scotch thistle	*Onopordum acanthium*	3
Curveseed butterwort	*Ceratocephala testiculata*	3
St. Johnswort	*Hypericum perforatum*	3
Bull thistle	*Cirsium vulgare*	3
Common burdock	*Arctium minus*	4
Dyer’s woad	*Isatis tinctoria*	4
Medusahead	*Taeniatherum caput-medusae*	4
Perennial pepperweed	*Lepidium latifolium*	4
Perennial sowthistle	*Sonchus arvense*	4
Plumeless thistle	*Carduus acanthoides*	4
Purple loosestrife	*Lythrum salicaria*	4
Quackgrass	*Elymus repens*	4
Skeletonleaf bursage	*Ambrosia tomentosa*	4

Appendix A lists the protection measures for the preferred alternative.

Integrated Pest Management

Integrated pest management (IPM) is a key part of the preferred alternative. The preferred alternative would utilize a variety of tools, alone or in combination, to implement integrated pest management.

- Manual or mechanical treatment, such as hand-pulling, grubbing, mowing or cutting.
- Revegetation, where competitive vegetation is seeded to reduce invasive species, possibly after other treatments.
- Grazing with livestock. This includes targeted grazing with sheep, goats, or cattle through a contract and targeted grazing with livestock permitted to graze on the MBRTB under a term or temporary grazing permit or agreement.
- Biological control through the use of predators and parasites (for weed suppression, this primarily refers to insects) or plant pathogens (e.g., fungi, bacteria, viruses). Insects (gall fly, weevils, beetles) are the only biological control currently in use on the MBRTB.
- Herbicide control using ground-based application methods.
- Herbicide control using aerial application methods.
- Prescribed fire in conjunction with other treatment methods.
- Education to inform people of the effects of invasive plant infestations, methods of spread, and prevention opportunities and practices.
- Prevention practices that reduce invasive plant spread, including a weed-free forage program and washing vehicles to remove seeds.

With the exception of aerial herbicide application, all of these IPM treatment and prevention methods are part of the current weed management program (the no action alternative).

Selection of control methods is not a choice of one tool over another but rather selection of a combination of tools that would be most effective on target species for a particular location. Reliance on one method or restricting use of one or more tools may prove less effective. Effectiveness and applicability of each tool vary and depend on invasive plant biology and ecology, location and size of the infestation, environmental factors, management objectives, and management costs. Appendix C identifies example treatment(s) for each target invasive plant species using the treatment methods listed above.

The MBRTB proposes to use the strategy outlined in the table below to help select the most appropriate and effective control method. However, based on site-specific conditions and circumstances, strategies may change. Following EPA labels and APHIS direction (for biological control agents) and implementing resource protection measures will ensure that treatment methods are properly used.

Table 3. Guidelines for selecting and prioritizing treatment.

BIOLOGICAL CONTROLS WILL BE EMPHASIZED ON / IN: Large infestations of weeds for which there is an effective biocontrol available that are in • Stream, riparian and wetland areas, • Rough terrain, and/or • Areas where herbicide use is restricted or problematic (highly permeable soils, high water tables)
GROUND HERBICIDE APPLICATION WILL BE EMPHASIZED ON: • Weeds for which no accepted and effective biological controls are known • New infestations • Small infestations • Easily accessed infestation sites • Edges of large infestations • Ownership boundaries • Oil well sites (producing and rehabilitated) • Sites where biological controls are not effective
AERIAL HERBICIDE APPLICATION WILL BE EMPHASIZED ON: • Large infestations of weeds that do not have effective biological controls available, especially those in inaccessible or remote areas. • Infestations in areas of critical habitat where ground application cannot be done safely or effectively.
MANUAL AND MECHANICAL TREATMENTS WILL BE EMPHASIZED ON: • Infestations where other treatments are not effective • Small infestations where it is effective and practical
GRAZING WILL BE EMPHASIZED FOR USE: • On infestation areas where other methods are not effective or allowed • Where herbicide application is not practical • Where biological control methods are ineffective • On large infestations
REVEGETATION WILL BE EMPHASIZED FOR USE: • In combination with other treatments to revegetate bare ground
FIRE WILL BE EMPHASIZED FOR USE: • To enhance the effectiveness of other treatments (biological, herbicides, and in revegetation efforts)
PREVENTION AND EDUCATION: • Prevention and education are ongoing programs.
PRIORITY FOR TREATMENT: • Threatened, endangered, candidate, or sensitive species habitats • New infestations of new species • New infestations of existing species (outside currently infested areas) • Fast spreading species • Areas with high probability of success • Perimeters of existing infested sites • Sensitive plant habitat and rare plant communities • Ownership boundaries • Areas likely to accelerate weed spread (for example, trails, trailheads, roads) • Areas where adjacent landowners are actively working to control infestations

Adaptive Management Strategy

The preferred alternative includes the concept of adaptive management to deal with infestations that are constantly changing. Adaptive management offers a way to describe and evaluate the consequences of changing or new infestations and new treatment options while still addressing other resource concerns.

The adaptive management strategy consists of two principle components:

1. Use of a decision tree (see figure 2) to select treatments for new infestations. The decision tree is based on infestation size, location, site characteristics, and consultation with specialists.
2. Evaluation of new technology, biological controls, or herbicides to improve treatment effectiveness and reduce impacts.

New technology, biological controls, herbicide formulations, and supplemental labels are likely to be developed within the life of this project. New treatments would be considered if they are more species-specific than methods currently used, less toxic to non-target vegetation and other organisms, less persistent and less mobile in the soil, or more effective. An adaptive management strategy would allow use of new treatment methods if they meet the following criteria:

- The new or existing herbicide must have an EPA-approved herbicide label. Application must follow label specifications.
- An MBRTB assessment team would evaluate new herbicides that become available after this analysis. The team would review the EPA's registration eligibility decision for new herbicides and determine if the herbicides are appropriate for use on the forests and grassland.
- New biological agents must be detrimental to the target plants and virtually harmless to native or desirable non-native plants.
- New biological agents must be approved by USDA Animal, Plant Health Inspection Service (APHIS) and the states of Colorado and Wyoming prior to their introduction.
- An FSH 1909.15, 18.4 (Section 18) review will be conducted to determine if the effects of the new or existing herbicide are consistent with those identified in this project.
- Mechanical methods of treatments must be cost effective. These methods would be reviewed before use to determine if other resource quality standards can be maintained.

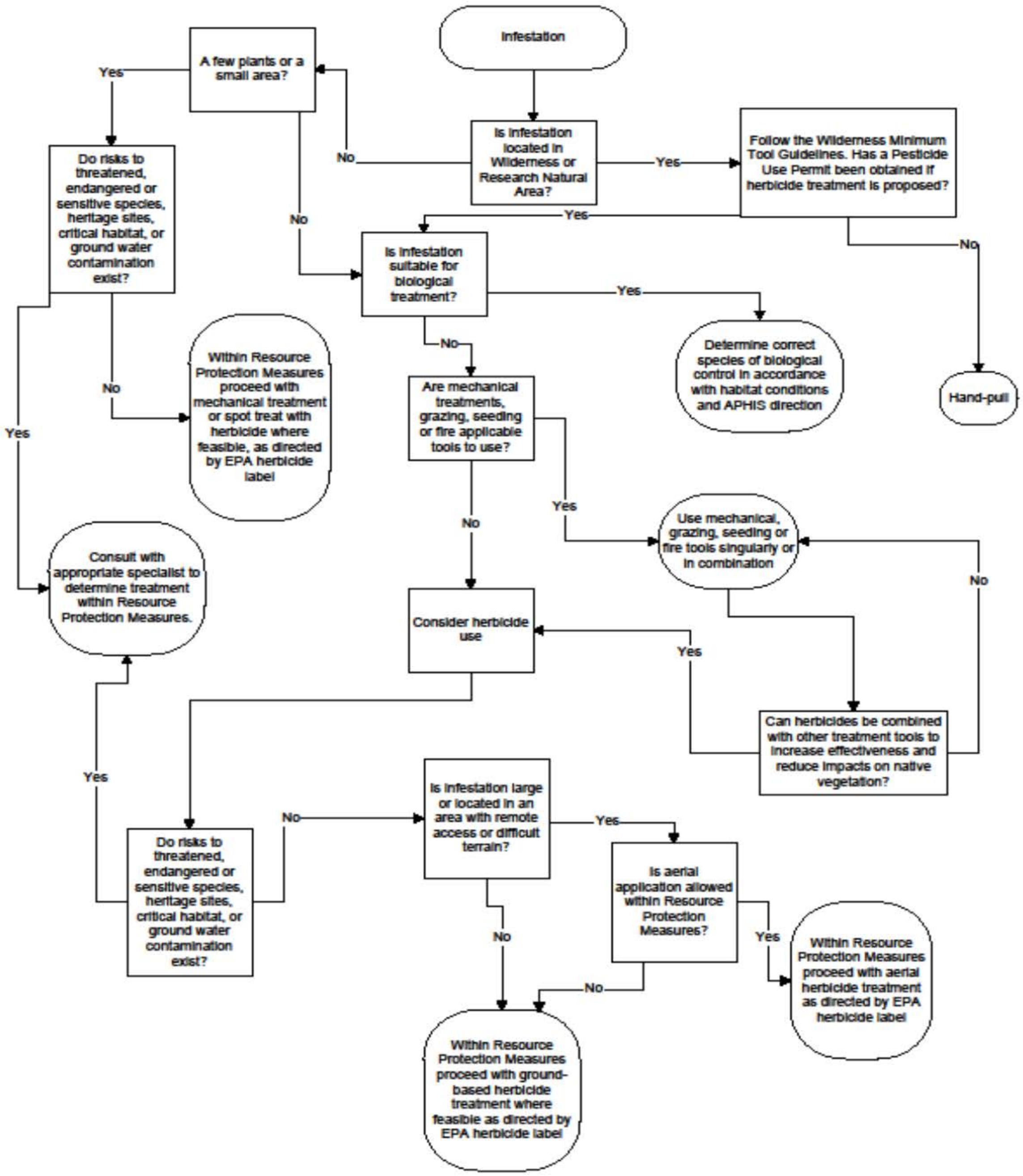
Alternative 3 – No Aerial Application of Herbicides

Alternative 3 is the same as the preferred alternative (alternative 2), except that it would not include aerial herbicide application. Alternative 3 allows treatment of approximately 2,000 – 3,000 acres per year on the MBRTB using a combination of ground-based herbicide application plus manual, mechanical, biological, and cultural control methods. The integrated and adaptive management strategies for the preferred alternative would be available under alternative 3.

Without aerial application, this alternative would treat fewer acres than alternative 2, and a very small percentage of the estimated 97,000 cheatgrass-infested acres would be treated. Many of the cheatgrass infestations cannot be treated with vehicle-mounted herbicide sprayers, biological control agents are not available, and other control techniques are labor intensive or not practical due to site characteristics. Traditional funding levels would not support much cheatgrass treatment after priority one species have been treated.

Appendix A lists protection measures for alternative 3.

Figure 2. Decision tree to select treatment methods.
(Double click on the decision tree to open a larger version in Acrobat)



Alternative 4 – No Herbicide Use

Herbicides would not be used in this alternative. The adaptive and integrated management strategies described below would apply. New and existing weed species and infestations could be treated as encountered under this alternative, and any newly approved biological controls could be used. This alternative does not meet the purpose and need for the project; however, it was included as a point of comparison.

Integrated Pest Management

Alternative 4 would use integrated pest management as described below:

- Manual and mechanical treatment, such as hand-pulling, grubbing, mowing, or cutting.
- Revegetation, where competitive vegetation is seeded to reduce invasive species, possibly after other treatments.
- Grazing with livestock. This includes targeted grazing with sheep, goats, or cattle through a contract and targeted grazing with livestock permitted to graze on the MBRTB under a term or temporary grazing permit or agreement.
- Biological control through the use of predators and parasites (for weed suppression, this primarily refers to insects) or plant pathogens (e.g., fungi, bacteria, viruses). Insects (gall fly, weevils, beetles) are the only biological control currently in use on the MBRTB.
- Prescribed fire in conjunction with other treatment methods.
- Education to inform people of the effects of invasive plant infestations, methods of spread, and prevention opportunities and practices.
- Prevention practices that reduce invasive plant spread, including a weed-free forage program and washing vehicles to remove seeds.

Adaptive Management Strategy

Alternative 4 would use the following adaptive management strategies:

1. Use of a decision tree (see figure 2) to select treatments for new infestations. The decision tree is based on infestation size, location, site characteristics, and consultation with specialists.
2. Evaluation of new technology and biological controls to improve treatment effectiveness and reduce impacts.

New technology and biological controls are likely to be developed within the life of this project. New treatments would be considered if they are more species-specific than methods currently used, more effective, or both. An adaptive management strategy would allow use of new treatment methods if they meet the following criteria:

- New biological agents must be detrimental to the target plants and virtually harmless to native or desirable non-native plants.
- New biological agents must be approved by USDA Animal, Plant Health Inspection Service (APHIS) and the states of Colorado and Wyoming prior to their introduction.

Between 500 and 1,200 acres of weeds could be treated annually under this alternative. However, many weed infestations would not be effectively treated because (1) there is not an approved biological control agent or available agents have very limited effectiveness; (2) the weed patch is too large and cannot be hand pulled because of lack of resources; and/or (3) the plant spreads via roots and the extensive soil disturbance required to treat it is not acceptable.

Manual and mechanical treatments would only occur in areas with low weed density (a few weeds per acre) for maximum cost effectiveness. With cultural treatments such as seeding native plants without removing the weeds, seedling survival would be limited due to competition from the weed species. Biological control agents that are currently available would only reduce the plant density of a few weed species (most agents have not been effective) and would not prevent the weeds from spreading into new areas.

Without the use of herbicides, all other control measures would be limited in scope and effectiveness. Some treatments would likely be prohibitively expensive.

Appendix A lists protection measures for alternative 4.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required by NEPA to explore and evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). During scoping and the comment period on the DEIS, the public suggested alternative methods for achieving the purpose and need. Several alternatives for the proposed project were considered but eliminated from detailed analysis. Reasons for their dismissal include not meeting project purpose and need; not meeting CEQ (NEPA) guidelines of being reasonable, feasible, and viable; not differing substantially from other alternatives being analyzed in detail; being beyond the scope of the EIS; and/or not complying with current laws, regulations, policies, and forest and grassland plan direction. The alternatives and the rationale for their dismissal are summarized below.

Exclude an area of approximately 8,020 acres from ground or aerial herbicide application.

The intent of this alternative is to provide a buffer for three individuals with sensitivity to chemical agents. The property being buffered is in the Centennial Valley at T14N, R77W, sections 7 and 18. This alternative was eliminated from detailed analysis because excluding more than 8,000 acres from treatment is not consistent with purpose and need of meeting existing law, regulation, and agency policy for treating non-native and invasive plants. The Forest Service is directed by law, regulation, and agency policy to treat non-native and invasive plants.

The proposed exclusion zone contains infestations of Dalmatian toadflax around the town of Albany, around Lake Owen, and along the rails-to-trails trail (Pers. comm. with Aaron Swallow, 2014). The Cheyenne Board of Public Utilities manages the aqueduct that runs through the proposed exclusion zone. Our agreement with them grants them an easement to access and manage the aqueduct. Noxious weed control is a requirement in the easement. (Pers. comm with Patricia Hesch, 2014). There is oxeye daisy along the aqueduct and possibly also Dalmatian toadflax, musk thistle and Canada thistle. Canada thistle, Dalmatian toadflax and oxeye daisy are all rhizomatous weeds that are very difficult to treat effectively via mechanical, cultural, or biological means.

The July 2014 Owen Fire burned approximately 397 acres in the proposed exclusion zone. The fire was north of Lake Owen in sections 23, 24, 25, and 26. The post-fire, burned area assessment report (BAER) documented cheatgrass, Canada thistle, musk thistle, and yellow toadflax near the burned area. Cheatgrass invasion could create large-scale, possibly irreversible, degradation to landscape appearance and ecosystem function. Thistle and toadflax populations have increased following other fires in the area so populations may increase after the Owen fire as well (BAER 2014). Annual weeds like cheatgrass or medusahead are able to take advantage of the flush of available nitrogen and can dominate plant communities after a fire (Haas 2014). The BAER recommends inspecting the area in the fall of 2014 to determine the presence of cheatgrass, Canada thistle, musk thistle, and yellow toadflax, and treating the area in the fall or spring to control or contain these invasive plants.

The application of straw mulch and/or grass seed (even certified noxious weed free seed) in post-burn rehabilitation measures increases the likelihood of cheatgrass seed introduction (Haas 2014). The BAER recommends hand application (or chipping from road) of straw or wood mulch and straw wattle installation in portions of a 6-acre contributing drainage area around Lake Owen.

The proposed herbicide exclusion zone includes about 1,250 acres of crucial deer and elk winter range. These acres are vulnerable to cheatgrass infestation following a wildfire because of site characteristics and the proximity of a large reservoir of cheatgrass seed. Failure to effectively treat cheatgrass would reduce the value of the area for wintering big game species. This is not consistent with forest plan management area direction which states, “Focus vegetation management on meeting wildlife winter range habitat objectives.” (Medicine Bow forest plan, chapter 2, vegetation standard 2)

Prohibit all activities that spread invasive plants.

The intent of this alternative is to address and take action on human activities that promote the spread of weeds. The alternative proposed closing roads; modifying authorized livestock grazing permits; and altering or eliminating existing timber, mining, and recreational OHV activities. These human uses and activities are authorized in the records of decision for three land and resource management plans. The three plans meet the requirements of several public land laws and regulations authorizing multiple uses on NFS lands. Taking action on activities previously authorized under existing laws, regulations, permits, and the three land and resource management plans is beyond the scope of this EIS; this alternative was not considered further.

No invasive plant management treatments.

An alternative that discontinues the current weed management program was considered but eliminated from detailed analysis because it does not meet any of the project purposes. It does not comply with the MBRTB’s integrated pest management program, is inconsistent with Forest Service policy that noxious weeds and their adverse effects be managed on NFS lands, and it violates federal and state laws and executive orders.

Use herbicides only after other treatment methods have failed.

This alternative was eliminated because of the concern that if the non-herbicide treatments fail and some time passes before this failure is determined, the weed infestation may expand well beyond the original acreage and further impact forest and grassland resources. The resulting need for follow-up treatments would then have greater potential impacts than the original action. Such an occurrence would not meet the project purpose and need.

Climate change and global warming effects on resource conditions

This alternative was eliminated from further consideration because current science is insufficient to determine a cause-and-effect relationship between climate change and invasive plant management treatments. The preponderance of current literature suggests that "most of the important elements of global change are likely to increase the prevalence of biological invaders" (Dukes and Mooney 1999). Ziska and others (2010) noted the potential for increased spread of invasive species in response to rising CO_2 levels, increasing surface temperature, and the likely instability of weather and precipitation patterns. Kerns and Guo (2012) reported the increased likelihood of invasive species spread from increases in temperatures, precipitation changes, increased ecosystem disturbances, increased competitiveness due to elevated CO_2 levels, and increased stress on native species and ecosystems.

There is no way to quantify increases or decreases in CO_2 between alternative 2 which treats the maximum acres of invasive species and alternative 4 which treats the minimum. Similarly, not enough research has been conducted on invasive species to know which species will respond positively or negatively to increases in CO_2.

Recommended management responses to these predictions are early detection (resulting from regularly scheduled monitoring) followed by a rapid response to eradicate initial infestations (Hellmann et al. 2008, Joyce et al. 2008, Tausch 2008, Kerns and Guo 2012). Early detection and rapid response are included in the all four alternatives.

Comparison of Alternatives

This section summarizes the effects of implementing the alternatives. The comparison focuses on activities with effects or outputs that can be distinguished quantitatively or qualitatively between alternatives. The alternatives are compared by their design, their components, or by the environmental, social, and economic effects of implementing them.

Table 4. Comparison of alternatives.

Item to Compare	Alternative 1 No Action	Alternative 2 Preferred Alternative	Alternative 3 No Aerial Application of Herbicides	Alternative 4 No Herbicides
Approximate acres treated annually – based on present funding levels	2,000-3,000	3,000-8,000	2,000-3,000	500-1,200
Herbicides available for use at present	Chlorsulfuron, clopyralid, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr and 2,4-D.	Aminopyralid, chlorsulfuron, clopyralid, dicamba, fluroxypyr, glyphosate, hexazinone, imazapic, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr, and 2,4-D.	Same as Alternative 2	None
Adaptive management features	Treat new invasive species only if listed by Wyoming or Colorado as "noxious farm weeds." Treat new infestations of listed weeds. Use new, approved biological control agents.	Treat any new invasive species that threaten native plant communities. A species does not have to be listed as a noxious farm weed to be treated. Treat existing and new infestations of invasive species. Use new, approved biological control agents. Use new registered and approved herbicides.	Same as Alternative 2	Treat any new invasive species that threaten native plant communities. Treat new infestations of invasive species. Use new, approved biological control agents.
Aerial herbicide application	No	Yes	No	No
Issue #1 Effects of invasive species on native vegetation, biological diversity, structure and production.	Reduces or prevents spread of infestations of the listed invasive plant species. Does not reduce negative effects of cheatgrass or other invasive plants not listed as noxious farm weeds by the States of Colorado or Wyoming. Some weed species will continue to increase, with negative consequences to native plant communities and wildlife.	More adaptive and integrated management options to treat invasive plant species. Allows treatment of all new invasive plant species of concern. Offers the best opportunity to reduce large infestations of cheatgrass. Minimizes negative impacts by employing the widest array of control measures compatible with other resource values.	Similar effectiveness as alternative 2 with the exception of cheatgrass. Without aerial application, very few acres of cheatgrass would be treatable on an annual basis; infestations are likely to remain large and increase in size.	Relatively ineffective in reducing negative effects from over half the invasive species known to occur on the MBRTB. Available control methods don't allow treatment of enough acres to slow weed spread because they are ineffective; create too much ground disturbance; or take too much time, labor, and money.

Item to Compare	Alternative 1 No Action	Alternative 2 Preferred Alternative	Alternative 3 No Aerial Application of Herbicides	Alternative 4 No Herbicides
Issue #2 Effects of herbicides on threatened, endangered or sensitive species and their habitats.	Low risk to TES species and their habitat due to protection measures in place. Some weed species and most large weed infestations of cheatgrass would not be treated, so habitat quality would be degraded for some plant and animal species. Sagebrush obligate species are likely to be negatively affected by the lack of effective cheatgrass treatment.	Low risk to TES species and their habitat due to protection measures in place. All invasive species of concern could be treated, including large infestations of cheatgrass in important habitats for TES species.	Low risk to TES species and their habitat due to protection measures in place. Most cheatgrass infestations would not be treated, so habitat quality would be degraded for some plant and animal species. Sagebrush obligate species are likely to be negatively affected by the lack of effective cheatgrass treatment.	No risk to TES species and their habitat because no herbicides would be used. Lack of treatment and/or lack of effective treatment of many weed species and infestation sites would result in degraded habitat for some plant and animal species. Habitat for a variety of sensitive species may be negatively affected by an ineffective weed treatment program.
Issue #3 Effects of herbicides on soils, water and aquatic resources	Low risk of negative effects from herbicide treatment due to protection measures in place. Lack of effective treatment of many weed species and infestation sites could result in increased sedimentation and possible impacts to water quality and some aquatic organisms.	Low risk of negative effects from herbicide treatment due to protection measures in place, including those for aerial application.	Low risk of negative effects from herbicide treatment due to protection measures in place. Lack of effective treatment of many weed species and infestation sites could result in increased sedimentation and possible impacts to water quality and some aquatic organisms.	No risk, because no herbicides would be used. Lack of effective treatment of many weed species and infestation sites could result in increased sedimentation and possible impacts to water quality and some aquatic organisms.
Issue #4 Effects of herbicides on human health	**Risk of exposure, including drift** There is potential for exposure from ground-based herbicide application. There is less risk to the public from exposure to drift because there is no aerial spraying. Risk of worker exposure could be higher because ground-based treatment is less effective than aerial so more treatments may be required. Potential exposure would be reduced by following the herbicide label instructions and implementing the protection measures in appendix A.	**Risk of exposure, including drift** There is potential for exposure from ground-based herbicide application. Aerial spraying could increase the public's risk of exposure; however, this potential exposure would be reduced by following the herbicide label instructions and implementing the protection measures in appendix A. Aerial spraying reduces worker exposure to the herbicide. The person who mixes and loads the herbicide has less contact time; pilot who applies it is protected by the enclosed cockpit of the aircraft.	**Risk of exposure, including drift** There is potential for exposure from ground-based herbicide application. There is less risk to the public from exposure to drift because there is no aerial spraying. Risk of worker exposure could be higher because ground-based treatment is less effective than aerial so more treatments may be required. Potential exposure would be reduced by following the herbicide label instructions and implementing the protection measures in appendix A.	**Risk of exposure, including drift** No effect, because no herbicides would be used.

Item to Compare	Alternative 1 No Action	Alternative 2 Preferred Alternative	Alternative 3 No Aerial Application of Herbicides	Alternative 4 No Herbicides
Effects on human health, cont.	**Risk of doses exceeding EPA's reference dose (RfD)** For four herbicides, there is little risk to workers or the public because the maximum exposure would be less than EPA's RfD. Based on SERA's risk assessments, seven herbicides exceed the RfDs for chronic or acute exposure for the public or workers or both. Implementing the protection measures in appendix A would reduce the risk of exposure to both groups. All herbicides would be applied according to label instructions to minimize exposure and adverse health effects.	**Risk of doses exceeding EPA's reference dose (RfD)** For five herbicides, there is little risk to workers or the public because the maximum exposure would be less than EPA's RfD. Based on SERA's risk assessments, nine herbicides exceed the RfDs for chronic or acute exposure for the public or workers or both. Implementing the protection measures in appendix A would reduce the risk of exposure to both groups. All herbicides would be applied according to label instructions to minimize exposure and adverse health effects.	**Risk of doses exceeding EPA's reference dose (RfD)** For five herbicides, there is little risk to workers or the public because the maximum exposure would be less than EPA's RfD. Based on SERA's risk assessments, nine herbicides exceed the RfDs for chronic or acute exposure for the public or workers or both. Implementing the protection measures in appendix A would reduce the risk of exposure to both groups. All herbicides would be applied according to label instructions to minimize exposure and adverse health effects.	**Risk of doses exceeding EPA's reference dose (RfD)** No effect, because no herbicides would be used.
	Effects to sensitive subgroups See potential effects summary for alternative 2 for chlorsulfuron clopyralid dicamba glyphosate hexazinone imazapyr metsulfuron methyl picloram sulfometuron methyl triclopyr 2,4-D	**Effects to sensitive subgroups** In animals studies, **aminopyralid** did not appear to have any remarkable systemic toxic effects (SERA 2007). Individuals who are immuno-compromised or those with diseases that compromise cell integrity (e.g., sickle cell anemia) may be unusually sensitive to **2,4-D** (SERA 2006). **Chlorsulfuron** may cause changes in the blood or in blood producing organs but effects on people with pre-existing blood or metabolic disorders are not clear (SERA 2004d).	**Effects to sensitive subgroups** See potential effects summary for alternative 2 for all herbicides except imazapic.	**Effects to sensitive subgroups** Sensitive subgroups would not be affected because herbicides are not used.

Item to Compare	Alternative 1 No Action	Alternative 2 Preferred Alternative	Alternative 3 No Aerial Application of Herbicides	Alternative 4 No Herbicides
Effects to sensitive subgroups, cont.		It is not clear whether individuals with pre-existing kidney, liver, or blood diseases would be more sensitive to **clopyralid** exposure because effects varied among different animal species tested and also between studies of the same species (SERA 2004a). **Fluroxypyr** – the mechanism of excretion involves active uptake by, and concentration in, the kidneys; thus, individuals with kidney diseases might be more sensitive to this herbicide (SERA 2009). The most sensitive subgroup for exposure to **glyphosate**, glyphosate formulations, and **hexazinone** appears to be pregnant women and the developing fetus (SERA 2011a, 2005). It is unclear if people with pre-existing diseases of the hematological system, muscle, or liver would be particularly sensitive to **imazapic** exposure (SERA 2004c). Given the very low hazard quotients for **imazapyr**, there appears to be no basis for asserting that adverse effects in a specific subgroup are plausible (SERA 2011d). If exposure levels to **metsulfuron methyl** were sufficient to induce decreases in serum glucose, people taking medication to lower serum glucose could be at increased risk; however, this exposure scenario is highly implausible (SERA 2004e).		

Item to Compare	Alternative 1 No Action	Alternative 2 Preferred Alternative	Alternative 3 No Aerial Application of Herbicides	Alternative 4 No Herbicides
Effects to sensitive subgroups, cont.		Individuals with kidney disease could have an impaired ability to excrete **picloram**, as well as many other weak acids; however, the SERA risk assessment did not identify any reports linking picloram exposures to adverse effects in individuals with kidney disease (SERA 2011b). Individuals with pre-existing anemia could potentially be at an increased risk from **sulfometuron methyl** exposure (SERA 2004f). **Triclopyr** is excreted primarily by the kidney so individuals with kidney disease could have an impaired ability to excrete it (SERA 2011c).		

Table 5. Estimated acres treated by treatment method and alternative – based on present funding levels.

Treatment options	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Biological control	100 - 300	100 - 300	100 - 300	100 - 300
Biological control - grazing and browsing	0 - 250	0 - 250	0 - 250	200 - 500
Mechanical[1] low ground disturbance	100 - 200	100 - 200	100 - 200	150-300
Mechanical[2] moderate to high ground disturbance	0-50	0-50	0-50	100 - 200
Ground application of herbicide	1,500 - 2,500	1,500 - 2,500	1,500 - 2,500	0
Aerial application of herbicide	0	1,000 - 5,000	0	0
Prescribed fire	100 - 200	100 - 200	100 - 200	150 - 300

[1] Includes hand-pulling or grubbing, mowing, cutting
[2] Revegetation –disking, drilling, reseeding

Chapter 3. Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the physical and biological environments of the project area and the effects of implementing each alternative on that environment. Direct, indirect, and cumulative effects are addressed. It also presents the scientific and analytical basis for comparing the alternatives in chapter 2. Each resource section summarizes a more detailed analysis presented in the specialist reports. Those reports are in the project record at the MBRTB supervisor’s office.

Cumulative effects are addressed by resource. Past actions considered in the cumulative effects analyses include livestock grazing practices and associated developments, past weed treatments by both the agency and adjoining landowners, timber sales, oil and gas development on the MBRTB including road and pad construction, other road and trail construction and maintenance, recreational activities, spread of invasive species (other than noxious weeds), and the conversion of native prairie to other uses. Current and reasonably foreseeable activities that could contribute to the degree of impacts include travel planning (including potential reconstruction and decommissioning of routes), livestock grazing practices, continued herbicide and/or other chemical application for both noxious weeds and agricultural purposes by adjoining landowners, anticipated increases in recreation use and developments such as campgrounds and trails, and oil and gas activities.

Events such as wildfire, drought, landslides, blowdowns, and bark beetle epidemics will continue to create disturbances that help invasive species establish and spread. All have potential to introduce new weed species, introduce weeds to new locations, or facilitate spread of existing infestations. Climate change is another factor likely to stress native plant communities and perhaps create an ecological advantage for invasive species. Most invasive species flourish because they can cope with challenging growing conditions. The effects of these natural disturbances are described in the affected environment sections.

Issue #1 Native Vegetation and Invasive Species

Affected Area

The analysis area for native vegetation and invasive species includes all vegetation communities near proposed treatment areas or those habitats where weeds have potential to invade. These plant communities have the potential to be directly or indirectly affected by weeds and proposed treatment methods.

Analysis Method

Information used came from data on file at the MBRTB district offices, literature review, and personal communication with resource specialists who have knowledge of vegetation, weed control, and herbicide effects. Acreage estimates of vegetation cover types were derived using GIS. Much of the information was assembled for the forest and grassland planning efforts.

Affected Environment – Vegetation

Components of the affected vegetation are the weed species themselves and the native plants communities adjacent to weed infestations or within which weeds are found. The vegetation information is presented in the following sub-sections: Weed Species, Weed Ecology, Native Plant Communities, Vulnerability to Infestations, Human Activities and Invasive Species, and Present Weed Management Practices.

Weed Species

Floristic surveys conducted by the Rocky Mountain Herbarium on and adjacent to the MBRTB between 1988 and 2008 indicated there were over 1,000 unique plant species, including at least 110 non-native species (not native to the area) and at least 15 noxious weed species. The term noxious weeds, as used here, refers to those non-native plant species that have been officially listed by the states of Colorado and Wyoming or their counties as harmful and therefore targeted for control and prevention efforts. The number of non-native species and noxious weed species present on the MBRTB has likely increased since these surveys were completed, particularly for areas surveyed over 5 years ago, as invasive plant species continue to arrive on the MBRTB in a variety of ways.

Weeds proposed for treatment on the MBRTB are listed in tables 2 and 6. Table 2 lists the weed species status in Wyoming and Colorado and treatment priority for the MBRTB. Table 6 has estimated acres of infestation for each species in 1995 and in 2010.

Of the 26 species documented on the MBRTB, 22 have either increased or first appeared in the past 15 years. Those that have increased the most are dalmatian toadflax, yellow toadflax, diffuse knapweed, saltcedar, hoary cress, scentless chamomile, houndstongue, oxeye daisy, and cheatgrass. New infestations are found with increasing frequency, and acreage estimates do not represent a complete weed inventory. Acres of cheatgrass infestation were not recorded in 1995, as the species was not considered a significant threat at that time. With the beginning of the severe drought that started in 1999, land managers on the MBRTB saw rapid increases cheatgrass infestations that continue today. Cheatgrass now occupies more area than all the other documented invasive species combined, over 97,000 acres.

Populations of a few species (leafy spurge, musk thistle, and spotted knapweed) appear to have decreased since 1995. If the MBRTB has achieved some measure of success with leafy spurge, spotted knapweed, and musk thistle, it is because the first two are high priority for treatment and effective herbicides exist and the third (musk thistle) has been treated with biological, mechanical, and chemical methods since the early 1990s.

Due to their dynamic nature, it is not possible to list all invasive species that may be considered a threat to NFS lands. The many uses and activities that occur on MBRTB lands create numerous opportunities for new invasive plant species to be introduced. Management of species that may be a threat in the future is addressed in the adaptive management strategy described in chapter 2.

Table 6. Change in acres of invasive plant species present on the MBRTB from 1995 to 2010 and invasive plant species likely to become established in the future.

Common Name	Scientific name	1995 Approximate Infested Acres	2010 Approximate Infested Acres
Species currently present			
Dalmatian toadflax	*Linaria dalmatica*	302	1,907
diffuse knapweed	*Centaurea diffusa*	10	260
leafy spurge	*Euphorbia esula*	2,716	863
Russian knapweed	*Acroptilon repens*	1	9
saltcedar	*Tamarix* complex	0	280
spotted knapweed	*Centaurea stoebe* ssp *micranthos*	642	266
squarrose knapweed	*Centaurea virgata* ssp *squarrosa*	0	3
yellow toadflax	*Linaria vulgaris*	4,446	8,499
black henbane	*Hyoscyamus niger*	0	36
bull thistle	*Cirsium vulgare*	0	264
cheatgrass	*Bromus tectorum*	Unknown	97,461
common tansy	*Tanacetum vulgare*	0	5
hoary cress	*Cardaria draba*	105	1,374
musk thistle	*Carduus nutans*	5,898	2,200
Russian olive	*Elaeagnus angustifolia*	Unknown	350
scentless chamomile	*Tripleurospermum perforatum*	0	254
Scotch thistle	*Onopordum acanthium*	16	21
St. Johnswort	*Hypericum perforatum*	0	2
sulphur cinquefoil	*Potentilla recta*	0	1
Canada thistle	*Cirsium arvense*	39,280	44,598
common burdock	*Arctium minus*	152	53
common mullein	*Verbascum thapsus*	Unknown	199
curveseed butterwort	*Ceratocephala testiculata*	0	4
field bindweed	*Convolvulus arvensis*	55	66
houndstongue	*Cynoglossum officinale*	993	15,034
ox-eye-daisy	*Leucanthemum vulgare*	0	1,288
Species likely to become established			
dyers woad	*Isatis tinctoria*		0
medusahead	*Taeniatherum caput-medusae*		0
perennial pepperweed	*Lepidium latifolium*		0
perennial sowthistle	*Sonchus arvense*		0
plumeless thistle	*Carduus acanthoides*		0
purple loosestrife	*Lythrum salicaria*		0
quackgrass	*Elymus repens*		0
skeletonleaf bursage	*Ambrosia tomentosa*		0

Weed Ecology

The invasive plant species listed in this document are not native to North America. They were largely introduced as contaminants in agricultural products or as ornamental plants. They gained a competitive advantage by leaving their natural enemies and disease behind on their continents of origin, and all have characteristics that allow them to compete aggressively with native vegetation in a variety of habitat types, as described below:

- Germination and growth very early in the spring, allowing them to utilize available soil moisture before native plants come out of dormancy (cheatgrass, medusahead, curveseed butterwort).
- Extensive creeping rootstocks that rapidly increase population size without the need for successful seed production (Canada thistle, leafy spurge, the toadflaxes, hoary cress, quackgrass, perennial pepperweed).
- The ability to secrete chemicals that inhibit growth of adjacent native plants (knapweeds, dyers woad). This characteristic is known as allelopathy.
- Toxic chemicals in leaves, stems and flowers that make them poisonous or unpalatable to many herbivorous animals which protects them from being grazed (leafy spurge, scentless chamomile, knapweeds, black henbane, curveseed butterwort, houndstongue, St. Johnswort).
- Spines on leaves and stems or awns on seeds that discourage consumption by herbivorous animals (the thistles, cheatgrass, medusahead).
- Prolific seed production.
- Seeds that remain viable for a long time.
- Excellent seed dispersal via wind, water, or animals.

Invasive plant species are well equipped to establish themselves wherever native plant communities have been altered by physical disturbance to soils, as well as in areas where native plants have been stressed by either natural or man-caused changes, including drought, fire (natural or prescribed), insect and disease outbreaks, chemical alteration (i.e. fertilization, salinization, herbicide application) or climate change. In recent years, two large scale natural disturbances, a severe drought and a regional mountain pine beetle epidemic, have significantly stressed and altered many native plant communities on the MBRTB. The effects are further discussed below in the *Vulnerability to Infestations* section.

Native Plant Communities

The nearly 3 million acres of the MBRTB support a diverse mixture of plant communities. On the Medicine Bow-Routt National Forests, the elevation range (from around 7,000 feet to over 12,000 feet) creates four different life zones, each with characteristic plant communities (see Table 7). Big sagebrush/grass plant communities make up the dominant cover type on the Thunder Basin National Grassland. True grasslands – those lacking a shrub component –make up about 12%.

Table 8 lists primary cover types on the three units that make up the MBRTB and approximate acres of each, rounded to the nearest hundred acres. These figures were derived from Forest Service vegetation databases and the environmental impact statements for the forest and grassland land and resource management plans. Databases vary somewhat in total acres and in acres of cover types depending on the mapping scale and vegetation typing protocols. For this table, total unit acres were taken from the R2VEG database, while cover type acreages were derived from a combination of forest/grassland plan EIS information and the R2RIS database.

Table 7. Plant communities and dominant vegetation on the MBRTB.

Medicine Bow-Routt National Forests	**Dominant Vegetation**
Foothills zone	Idaho fescue, Sandberg bluegrass, needle and thread grass, Letterman needlegrass, mountain brome, bluebunch wheatgrass, western wheatgrass, prairie junegrass
	mountain big sagebrush, Wyoming big sagebrush, silver sagebrush, bitterbrush, serviceberry, Gambel's oak, chokecherry, true mountain-mahogany, snowberry
	Rocky Mountain juniper
Montane zone	lodgepole pine, ponderosa pine, aspen, Douglas-fir
Subalpine zone	Engelmann spruce, subalpine fir, Colorado blue spruce
Alpine zone	sheep sedge, black alpine sedge, alpine bluegrass, arctic bluegrass, alpine avens, creeping sibbaldia, alpine clover, eightpetal mountain-avens, arctic willow
Riparian and wetland communities	grass/sedge meadows, forb-lands, willow and/or alder shrublands and narrowleaf cottonwood gallery forests
Thunder Basin National Grassland	**Dominant Vegetation**
Upland plant communities	needle and thread, green needlegrass, western wheatgrass, blue grama, buffalograss, threadleaf sedge
	Wyoming big sagebrush, greasewood,
	ponderosa pine, Rocky Mountain juniper (<2% of the grassland)
Riparian and wetland communities	cottonwood gallery forests, willow shrublands and grass/sedge meadows (~1% of the grassland)

Table 8. Estimated acres of the major vegetation cover types on the MBRTB.

Cover Type	Medicine Bow NF	Routt NF	Thunder Basin NG
Upland Non-forested Areas			
Dry grasslands	55,800	38,000	67,100
Forblands (mostly alpine and subalpine)	3,300	6,700	0
Sagebrush*	93,700	47,900	438,500
Other upland shrublands	19,800	14,100	28,900
Upland Forested Areas			
Aspen forest	83,900	260,400	0
Lodgepole pine forest	478,100	369,700	0
Ponderosa pine forest	98,000	0	8,800
Juniper forest	200	0	500
Douglas-fir forest	10,300	5,300	0
Limber pine forest	12,100	100	0
Spruce/fir forest	191,800	446,300	0
Riparian Areas and Wetlands			
Sedge-grass wetlands and riparian areas and alpine meadows	12,400	23,500	6,600**
Willow/alder/birch riparian shrublands	16,000	19,500	
Cottonwood riparian forest	400	100	100

Cover Type	Medicine Bow NF	Routt NF	Thunder Basin NG
Non-vegetated Areas			
Barren rock, roads, gravel pits, mines, water or areas with no vegetation data	8,600	22,300	2,900
TOTAL	1,084,400	1,253,900	553,400

*Primarily big sagebrush (*Artemisia tridentata*), but also black sagebrush (*Artemisia nova*), silver sage (*Artemisia cana*), threetip sagebrush (*Artemisia tripartita*) and little sagebrush (*Artemisia arbuscula*).

** Riparian shrublands and meadows lumped together.

Vulnerability to Infestation

Alpine vegetation: None of the weed species listed in this analysis are alpine specialists, and alpine vegetation communities are not generally at risk of invasion because site conditions are incompatible for the growth and establishment of most invasive species. However, infestations of yellow toadflax have been identified in alpine communities on the Routt National Forest. Climate change may increase susceptibility of these sites to invasion by non-natives in the future, depending upon the magnitude of temperature and moisture regime changes and the stresses those changes place on the native alpine plant communities.

Upland grasslands and upland shrub/grass cover types: Plant communities in these cover types are at greatest risk from non-native species invasion because environmental conditions where they are found are very similar to the conditions where many invader species originated. They are non-forested, only seasonally moist, and have patchy plant distribution that provides bare soil areas where introduced seed can easily germinate. Natural and man-caused disturbances regularly occur in these plant communities, including grazing/browsing by wild and domestic animals, wind erosion, mineral and energy exploration and development, unauthorized off-road vehicle use, wildfire, and prescribed fire. The majority of weed infestations being treated on the MBRTB are in these cover types. Collectively they occupy about 28% of the total acres on the MBRTB.

Cheatgrass is a particular concern on the Thunder Basin National Grassland where historical cultivation and grazing practices, wildfires, and black-tailed prairie dogs have created conditions favorable to invasive species by weakening or altering native plant communities. From 1999-2005, a severe drought impacted the upland grass and upland shrub-grass cover types. A notable effect of the drought was the establishment and spread of dense cheatgrass stands in locations where it had not been seen before or where only scattered plants had previously been observed. Cheatgrass can rapidly alter site conditions by changing soil structure and organic matter content (Norton et al. 2004, Sperry et al. 2006), crowding out most native grasses and forbs, and changing the natural fire return interval from 30 or more years to more frequent intervals, potentially as short as every 3-4 years.

On the Medicine Bow-Routt National Forests, the largest cheatgrass infestations are on steep southward-facing (south, southeast, and southwest) sagebrush slopes that provide important winter feeding areas for mule deer, bighorn sheep and elk. In most cases, cheatgrass became dominant after wildfire or prescribed fire altered the native plant communities and soil nutrients.

Cheatgrass is the most abundant invasive species of concern on the MBRTB, but few acres have been treated due to the lack of effective and affordable treatment methods. Failure to treat all but a few small infestations of cheatgrass has contributed to its present abundance.

Wetlands and riparian plant communities: Many riparian areas and wetlands are relatively resistant to invasion by non-native species because the abundant moisture provides for vigorous and tightly packed native species with few bare areas for invading seeds to reach bare soil. However, some invasive species are well equipped to exploit even very limited opportunities and can still become established and spread in these types of plant communities. Canada thistle, saltcedar, Russian olive, and purple loosestrife are examples of invasive species that are able to gain a foothold in riparian areas and wetlands. Although leafy spurge is not considered a moisture-loving plant, it can flourish in well-drained river cobbles and gravel bars along stream courses.

Aspen forest plant communities: The aspen plant communities on the Medicine Bow and Routt national forests (MBR) do not appear to be at high risk from invasion by non-native plants unless they undergo an extreme disturbance such as fire or die-off from insects or disease. The combination of shade from the tree canopy; deep, moist soils; and the presence of rhizomatous and otherwise competitive native understory species limits opportunities for non-native species to become established.

In recent years, many mature aspen stands on the MBR have been dying from a combination of stress caused by the severe drought of 1999-2005 and opportunistic insect and disease attacks. The die-off has affected over 31,000 acres (Harris 2011). In many stands, new aspen sprouts are being produced from the roots (a process called suckering) as the mature trees decline, and these stands are likely to remain at least somewhat shaded and moist as they regenerate and therefore relatively resistant to weed invasion. Aspen stands that exhibit weak suckering or no suckering will be more susceptible to invasive plants as they lose canopy cover and become more sunny and dry.

Coniferous forest plant communities: Recent widespread mortality of pine forests throughout the MBR (brought about by a mountain pine beetle epidemic of unprecedented scale) has altered their vulnerability to weed invasion. On the MBR, aerial detection surveys indicate approximately 1,177,000 acres of pine forest are dead or dying (Harris 2011), and most of the mature pines on the MBR will by dead by the time this mountain pine beetle epidemic runs its course. The result will be another million or more acres of land on the MBR that are moderately to highly vulnerable to weed infestation until pine regeneration is large enough to inhibit weed establishment. On the MBR, we are already seeing new thistle infestations in pine stands where the trees have been dead long enough to lose their needles.

Vulnerability increases when wildfire or ground-disturbing activities such as timber salvage and hazard tree removal occur in the dead and dying stands. The mountain pine beetle epidemic has increased the risk of wildfire because of a more receptive fuel bed (dead, dry fuels) and more continuous fuels. Over time, as dead trees start falling, ecological severity of wildfires will increase due to heavy fuels on the ground. Most invasive species are well adapted to colonizing sites where organic components of the soil have been removed by intense wildfire and/or subsequent erosion.

As new trees regenerate and grow in the beetle-affected areas, we are likely to see a decrease in weeds as ground shading increases. However, we have never observed tree mortality on such a large scale on the MBR, and there is a great deal of uncertainty as to how quickly and uniformly new forests will become established.

Human Activities and Invasive Species

Natural events can create conditions (bare soil, more sunlight, or reduced competition from native plants) where exotic weeds will flourish if introduced. Once a weed species is established, it can spread by wind, water, or wildlife but that may take many decades. Humans have the ability to accelerate the spread of invasive plants across the landscape. All of the following human activities can create sites conducive to weed establishment: road and trail construction and maintenance, timber harvest, recreation uses and activities, off-road vehicle use, irrigation ditch maintenance, livestock trailing and trampling, overgrazing, prescribed burning, wildfire suppression, dispersed camping, mining, energy development (wind farms, oil and gas exploration and development), and pipeline/power line construction and maintenance.

Human access to many parts of the MBRTB has improved markedly due to the construction or improvement of roads and trails and the increasing popularity of off-highway vehicles (OHVs). OHVs get more people further into remote areas than ever before, and they offer numerous cracks and crannies in which weed seeds can be transported. Spotted knapweed, in particular, appears to be very well suited to spread by motorized vehicles; it often appears in isolated locations along motorized routes far from any known seed sources.

Recreational vehicles are not the only vectors for introducing and spreading weeds on the MBRTB. Vehicles and heavy equipment are routinely used to maintain and repair roads, trails, campgrounds, and administrative sites; harvest timber; maintain irrigation ditches and power lines; fight fires; conduct prescribed burns; build and repair fences; and haul livestock and to monitor and administer these activities. The MBRTB uses equipment cleaning provisions for some activities (timber harvest, road construction and firefighting) to help prevent the introduction or spread of invasive plants, but these provisions are not required for all activities.

Weed seeds can also be introduced by hikers, pack and saddle horses, mules and llamas, pets, and domestic livestock, and wildlife species. Invasive species with seeds that cling to fur, feathers, and clothing are easily spread by humans and animals; cheatgrass, medusahead, houndstongue, curveseed butterwort, and common burdock are examples. Some livestock operators who graze permitted livestock on the MBRTB bring their livestock from remote wintering areas, some as far as California, so the opportunity exists to introduce weed seed from a long distance away via this practice. Another route for weed seeds to arrive is in hay or straw brought in for animal feed or mulch. The MBRTB requires any hay, straw or other plant-based animal feed brought onto the national forests or the grassland to be certified free of noxious weed seed, but this cannot always be enforced with limited law enforcement presence spread over a large area. In addition, certification only covers weeds listed by the state in which the feed was certified. It can therefore contain seed from a variety of unlisted invasive species.

Human activities associated with the forest's mountain pine beetle epidemic are disturbing the ground at a much larger scale than has occurred on the MBR for many decades. They include removal of dead and dying trees along roads and trails and in developed recreation sites such as campgrounds and picnic areas, creation of fuel breaks, and salvage logging and reforestation.

The TBNG has experienced accelerated oil and gas development and proposals for wind farms. These projects have greatly increased ground disturbance on the TBNG compared to what has historically occurred.

Present Weed Management Practices

The current weed treatment program on the MBRTB is described in the 1996 *Decision Notice and Finding of No Significant Impact for Management of Noxious Weeds* (USDA FS 1996). It is an integrated management approach using a variety of prevention measures and treatment methods as shown in the following two tables. The goal of integrated pest management is to manage undesirable plants so resource goals and objectives are met while minimizing adverse effects.

Table 9. Summary of weed prevention measures currently available for use on the MBRTB.

Prevention Measures	Discussion/Considerations
Seeding exposed soil	Most often used to reduce the likelihood of weed establishment on sites where native vegetation has been removed by a natural event (such as an intense wildfire or landslide) or management activities (such as gravel pit development or road construction). Locally derived, native plants are the first choice for seeding.
Cleaning of heavy equipment	Routinely used for forest/grassland projects before arrival of equipment on the MBRTB or when moving from infested sites to non-infested sites. Required in timber harvest/road construction contracts; can also be implemented in fire-fighting situations.
Requirement for certified noxious weed free hay, straw and other unprocessed livestock forage products	Required by regulation on the MBRTB. Certification means the forage does not contain any of the listed noxious weeds for the state in which it was grown. Despite this limitation, the regulation has likely been helpful in reducing new noxious weed infestations at dispersed campsites and trailheads.
Mulching	Occasionally used in conjunction with seeding to help establish desirable plant species and hold topsoil in place until revegetation is accomplished. Used at administrative sites (where there is landscaping) and on small areas where soils have been disturbed and the potential for erosion is high.

Table 10. Summary of treatment methods currently approved for use on the MBRTB.

Prevention Strategy	Discussion/Considerations
Cultural Control	
Competitive seeding	Occasionally used but only after weed populations have already been reduced by other control methods. Most effective on sites where seed drills can be used.
Grazing animals	Cattle grazing has been used to reduce cheatgrass on the TBNG. Successful weed control with grazing requires the appropriate type of livestock for the target weed species, and treatment must occur during the proper weed growth stage. Herding or close confinement of animals is usually required. This control method is often nonselective, meaning grazers may utilize native plants to an undesirable degree while also consuming invasive plants.
Use of fertilizer	Has not been used on the MBRTB for weed prevention. This tool must be used with care, as fertilizers can give invasive species a competitive edge over native species, particularly in bunchgrass plant communities.
Manual / Mechanical Control	
Hand-pulling/grubbing	This is the primary mechanical treatment method used on the MBRTB. It is labor intensive and only practical on small infestations of non-rhizomatous weed species. Used in sensitive areas such as habitat for threatened, endangered, or sensitive species; near water; or where an infestation consists of only a few plants.
Mowing/tilling	Seldom used due to high cost, ineffectiveness on many weed species, and impacts to native plant communities, particularly shrublands.
Mulching	Uses plastic, geotextiles or other materials to smother established weeds. On the MBRTB, this method has only been used to control weeds around buildings at some administrative sites.
Prescribed fire	Seldom used as a weed control method on the MBRTB unless it is to remove above-ground weed biomass prior to herbicide treatment so herbicides are more effective. Fire can increase a plant community's susceptibility to establishment and/or spread of some invasive species, particularly cheatgrass or medusahead.

Prevention Strategy	Discussion/Considerations
Biological Control	
Parasites, predators, and pathogens	Insects (gall fly, weevils, and beetles) are the only biological control currently in use on the MBRTB. They have been released since in the 1990s. They have had varied success, but most have not reduced existing weed infestations or prevented their spread.
Herbicides	
Ground application only	Application methods used on the MBRTB include backpack sprayers, packhorse-mounted spray equipment, and spray equipment mounted on OHVs or trucks. For woody species (Russian olive and saltcedar), herbicides are wiped on cut surfaces or injected. The following herbicides are currently used: chlorsulfuron, clopyralid, 2,4-D, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, and triclopyr. Herbicides are applied according to label specifications which include user safety recommendations; first aid; environmental hazards; directions for use, storage, and disposal; mixing and application rates; approved uses; and inherent risks of use. Herbicide application is performed by, or directly supervised by, a state-licensed applicator following all current legal application procedures administered by the Colorado or Wyoming departments of agriculture.

Environmental Effects

This section analyzes the effects of weed control activities on invasive plants and native vegetation. Effectiveness of various weed control techniques on the invasive weed species of concern are presented in *Appendix D – Response to Herbicides* and will not be repeated here.

Direct and Indirect Effects Common to All Alternatives

Under all alternatives, the MBRTB would continue to integrate manual, mechanical, biological, and cultural treatments to slow the spread of invasive plants and eradicate some infestations. When implemented properly, manual, mechanical, cultural, and biological weed treatment methods can reduce or prevent the spread of weed populations. However, none of the alternatives analyzed in this document will result in the treatment of all known infestations of weeds on the MBRTB if funding and manpower levels continue at present levels or at levels allocated over the past decade.

Potential effects are listed below by treatment method. The estimated acres that would be treated using these methods vary by alternative and are summarized in the *Comparison of Alternatives* section in chapter 2.

Hand-pulling/Grubbing – Neither hand-pulling nor grubbing are very effective on plants that can reproduce vegetatively from pieces of root or underground stems. Half of the invasive species listed in this document fall into this category. For non-rhizomatous, shallow-rooted invasive species, hand control is only effective if the plant has not yet produced seed or if repeated trips are made to remove young seedlings until the weed seed bank in the soil is exhausted. For some species, this can take seven or more years and often requires several visits per year.

Hand-pulling has very little negative impact to native plants and does not increase susceptibility to re-infestation or establishment of new invasive species if done on a small scale. If done on a large scale (with a large group of volunteers, for example, working on a large infestation), it could increase the amount of bare ground and result in trampling damage to native species interspersed with the target weeds. Test plots established on Blue Mountain (Lolo National Forest) and the Lee Metcalf National Wildlife Refuge near Stevensville, Montana, measured effects of hand pulling on spotted knapweed. On the two sites, spotted knapweed covered 76 percent and 53 percent, respectively. Hand pulling provided 100 percent flower control and 56 percent plant control at Blue Mountain but increased bare ground from 2.7 percent to 13.7 percent during the first year after treatment (USDA Forest Service 2005).

Grubbing, as used here, refers to digging out weeds that cannot simply be hand-pulled because they would break off at the surface, leaving the roots intact. It involves use of a shovel, mattock, hoe, or similar device to remove the root crown and larger roots. Like hand-pulling, it is very effective on some weed species and low impact to native plant communities if done on a small scale. On a large scale, it is cost prohibitive and has high impact to native vegetation due to the amount of soil disturbance.

Mowing – Very few acres are likely to be treated in this manner because it has limited effectiveness on many weed species and can only be effectively implemented on relatively flat terrain that does not have a very rough surface, large rocks, woody shrubs, trees or mowing-intolerant native plants. Because many invasive weeds flower throughout the summer, it is difficult to time mechanical treatments to prevent flowering and seed production. Repeated mechanical treatment too early in the growing season can result in a low weed growth form that is still capable of producing flowers and seed (DiTimaso 2001, Goodwin and Sheley 2001).

Mowing would mainly decrease the amount of seed production by weeds and weaken root and rhizome systems of creeping perennial weeds. Early forbs would be minimally affected if mowing occurs from midsummer through early fall, as they have produced seed and withered by that time. This would include many of the forbs in sagebrush, mixed mountain shrub, and dry grassland plant communities. Many grassland plant communities respond very well to mowing. They are adapted to defoliation and regrow readily. In some instances, where grasses have accumulated a lot of dead plant material, mowing can improve plant health, stimulating vigorous new growth.

Plant communities dominated by plants that cannot tolerate mowing (such as big sagebrush) would usually not be considered for such a treatment, as it would be counterproductive to the maintenance of healthy native plant communities.

Tilling – Tilling would injure or destroy above-ground plant biomass and the upper 4-12 inches of the underground root systems of most or all vegetation in the treatment area; it is not at all selective in its negative effects on native vegetation. For that reason, it has limited application and would have to be combined with an aggressive seeding treatment. The extent and location of tilling activities would be limited by terrain and soil characteristics, the need to minimize impacts on native plant species, and the nature of the weeds to be treated. Since very few acres would be treated using this method, it would have little impact on native vegetation on a district or forest scale.

Tilling is an ineffective method of control for weeds that reproduce vegetatively and can actually increase size and density of infestations (Goodwin and Sheley 2001). As mentioned above under the discussion of effects of hand-pulling and grubbing, half of the invasive species on the MBRTB reproduce by this method.

For invasive species that reproduce from seed, tilling can reduce seed production for the treated season; however, invasive weed seeds may remain viable in the soil for years (Stannard 1993, Messersmith et al. 1985). Field bindweed seed can reportedly remain viable for up to 50 years (Whitson 1996). Re-infestation from residual seed will often occur without continued follow-up treatment. In most cases, native species do not appear capable of out-competing invasive weeds when seeds of both are present on a tilled site.

Seeding – Seeding can be done by broadcast methods, in which the seed is scattered on the ground surface or with a seed drill. The overall effect on native vegetation is moderate to light, depending on the species composition of the plant community.

A seed drill is the preferred method where high rates of germination and seedling establishment are critical. On many sites on the MBRTB, a seed drill cannot be used due to the ruggedness of the terrain or because the plant community is mostly forested or shrub covered.

Broadcast seeding must be used on most sites, and it is sometimes very ineffective. Seeds may not land in locations conducive to germination or may be consumed by insects, birds, or small mammals. Competitive seeding is not likely to be effective on most highly invasive weeds unless the existing weed population is also treated by hand-pulling, mowing, tilling, or herbicide application.

The greatest potential impacts to native plant communities from seeding can come from the seed that is used. When purchased seed is used for revegetation, there is a risk of introducing non-native or invasive species or both. Use of certified weed-free seed is required on the MBRTB and reduces this risk but does not eliminate it.

If native plant seed is used to revegetate a site, but it is derived from a population that is not of local origin, there is a risk of negatively affecting the gene pool of the local population, so selecting seed from similar elevation zones is an important consideration. The plants that develop from non-local seed can interbreed with the local plants of the same species and introduce genetic traits that make the plants less fit for their environment. Protection measures listed in appendix A minimize this risk to native plant communities, but until commercially available, locally derived native seed supplies are developed, there will be some use of non-local native plant materials on the MBRTB.

Felling/Cutting (Russian olive, saltcedar) – This technique selects only the target species and is used for woody invasive species. Treatment of Russian olive and saltcedar is confined almost exclusively to the TBNG. Use of this technique without accompanying herbicide application is largely ineffective on Russian olive and saltcedar because both can resprout from the stump.

There is potential for some native plants to be negatively affected by this treatment method if slash is piled on them; however, this would be a short-term effect. Slash could help some native plants at a treatment site by protecting them from livestock or wildlife browsing and thereby improving their ability to fill in where the invasive plants were removed. On the TBNG, slash from Russian olive and saltcedar cutting has so far not been heavy enough to suppress native plant growth or require piling and/or burning.

Shade-adapted plants that were growing under the canopy of the targeted woody invasives may find their habitat too dry and sunny for long-term survival; however, they will naturally be replaced by other native plants adapted to a sunnier site. As native, woody plants establish themselves on the site (or are planted), native, shade-adapted understory plants will regain dominance in most cases.

Grazing – Grazing has mixed effectiveness on the target weed species and mixed impacts on native plant communities depending on how the grazing treatment is applied, the nature of the weed infestation, and the intermingled native plants. Heavy grazing and trampling can produce temporary negative effects to native plants. Where native woody plants are present, negative effects can be more long-term, particularly when goats are used for weed control. Browsing by goats may remove several years' worth of accumulated annual twig growth. Timing, stocking rate, and duration of the grazing treatment are critical to achieve weed control without long-lasting negative effects to native vegetation.

Appropriate grazing by animals preferring weeds can shift the plant community toward desired plant species (Stannard 1993). Conversely, grazing can selectively reduce competitiveness of native plants, shifting the community in favor of weeds (Vallentine and Stevens 1994, Kimball and Schiffman 2003). Most weed species are well adapted to invade heavily grazed areas, and some weed species have chemical or physical defenses (spines) that prevent them from being utilized by livestock. Grazing animals can be used to assist in weed control efforts but, in most cases, will not eradicate mature infestations when used alone.

Due to the need to closely confine livestock used in weed control, to protect them from predation (in the case of sheep and goats), and to apply grazing two or more times per growing season, grazing treatments are likely to be used on small areas for most weed species. Treatment of dense, large scale cheatgrass infestations would be an exception. Livestock can be penned on large cheatgrass infestations for a brief period in early spring when the grass is palatable and nutritious, provided the terrain is gentle enough and adequate water sources are available. TBNG has sites that are suitable for larger scale cheatgrass treatments through grazing, but the MBR mostly does not.

Prescribed Burning – Burning alone is seldom an effective weed control measure unless combined with other measures such as herbicide application and seeding. Many noxious weeds regenerate rapidly after a burn and compete with desirable species. Their populations can increase dramatically in response to the release of nutrients and the suppression of native competitors.

Prescribed burning suppresses or temporarily eliminates some native species and promotes regeneration of others. Most grasses, many forbs, and some woody species resprout readily after a cool burn or their seeds are adapted to take advantage of the newly bare soil. Most plant communities on the MBRTB evolved with fire and can recover if not hampered by invasive species, heavy grazing or browsing, or severe weather events such as prolonged drought.

Big sagebrush, a dominant shrub on the TBNG and foothills of the MBR, is often killed by fire, especially by fires occurring in the summer and fall. For big sagebrush to reclaim a site, it has to sprout from seed. Good spring conditions for sagebrush seed germination are often intermittent, so sagebrush recovery can take a long time on some sites or begin within a few years. Annual weeds such as cheatgrass and medusahead can dominate a plant community after a fire because they are able to take advantage of the flush of available nitrogen. This is particularly true in big sagebrush plant communities. Big sagebrush is effective in tying up nitrogen, and when it is killed by fire, soil nitrogen becomes available to aggressive annuals like cheatgrass and medusahead (Dakheel et al. 1993, Harris 1967, Lowe et al. 2002, Young and Allen 1997).

Biological Control Agents – On the MBRTB, insects are the only biocontrol agents that have been released, and most have had limited effectiveness. At present, there are no biological control agents available for fourteen of the thirty-four invasive species of concern. Biocontrol agents will never eradicate target weeds, but they can decrease populations and reduce seed production. They are usually a slow and partial weed treatment option.

Biological agents are selected and approved based on their host specificity and usually have little or no impact on native plant species. One exception has been the musk thistle seedhead weevil (*Rhinocyllus conicus*) which also infests native thistles that have large blossoms, such as the meadow thistle (*Cirsium scariosum*). In some areas, the meadow thistle now produces less viable seed due to infestation by this weevil.

The musk thistle seedhead weevil was the first biocontrol insect used on the MBRTB and was released in the early 1990s. The screening process employed by the Animal and Plant Health Inspection Service (APHIS) is much more rigorous than it was at that time, and none of the biocontrol insects released since the musk thistle seedhead weevils have been found infesting native plants. Despite rigorous screening, there is some potential for biocontrol agents to begin feeding upon native plant species. Once released, biological control agents can be difficult or impossible to eradicate if they become established and are found to have negative effects on native plant or animal species.

Use of biological control insects on the MBRTB has been only partially successful. It may take years to build a population that produces observable results in weed populations, and we may not know for years whether released biocontrol agents have successfully established. Some may not survive and reproduce in all the habitats in which the target weed exists, particularly in harsher high elevation sites. On some sites, the insect/weed life cycles may not be in good synchrony. On the MBRTB, the musk thistle seedhead weevil normally completes is life cycle before the musk thistle plant has finished blooming, so the weevils do not damage the seed of late-flowering plants.

Alternative 1 (No Change from Current Management) – Direct and Indirect Effects

Under this alternative, present management practices authorized by the 1996 NEPA decision would continue. An estimated 2,000-3,000 acres would be treated annually if present funding levels continue. A portion of these acres would be re-treatment, since many infestations require multiple treatments for eradication or containment. Effects of the manual, mechanical, cultural, and biological treatment components of this weed management program are described above in the *Effects Common to All Alternatives* section. The ground application herbicide treatment and adaptive management tools available under this alternative are discussed below.

Under alternative 1, lack of aerial treatment limits the MBRTB’s opportunities to work with surrounding landowners for a landscape approach to invasive species management. Because aerial application has not been available as a treatment method, federal land managers have not participated in cooperative weed management efforts to treat infestations that spread across federal and private land. In some cases, the treatment projects could not be carried out without federal participation and had to be abandoned. In other instances, patches of federal land were left untreated in the midst of the treated areas, creating a weed seed source to re-infest the treated acres that were privately owned or managed by states or other federal agencies.

Effects on invasive species

Under this alternative, some weed species may be eradicated and some prevented from spreading, but overall, acres of infestation are likely to increase. The limitations under this alternative – no new herbicides, no aerial application, and no treatment of weed species that are not listed by Colorado or Wyoming – reduce weed management effectiveness.

Herbicide treatment would be available for all the weed species of concern except curveseed butterwort, which is not a state listed noxious farm weed. Because it would not be treated, it would likely continue to spread from existing sites, and seeds would continue to be transported to presently uninfested sites by humans, livestock and wildlife. It has potential to become abundant in some grassland and shrubland locations and crowd out early native forbs. New invasive species that are not listed by the Colorado or Wyoming departments of agriculture could not be treated. This undermines a critical component of effective weed management, which is to treat newly arrived invasive species immediately before they can spread to unmanageable size.

Few, if any, cheatgrass infestations would be treated under this alternative because the MBRTB has no authorized selective herbicide to treat it, and aerial treatment is not an option. Livestock grazing is the only other treatment that could be applied to large cheatgrass patches, and it can only be used on parts of the TBNG and small, low elevation patches on the Medicine Bow and Routt national forests. Large cheatgrass patches on steep or broken terrain (many of them on big game winter range sites) would not be treated under this alternative and would continue to spread in suitable habitats.

Effects on native vegetation

Use of any of the herbicides available under this alternative could result in some damage to native vegetation; however, the protection measures, label restrictions, and selectivity of some of the herbicides minimize those negative effects. Since all herbicide application would be ground-based, there is little chance of herbicide drifting onto non-target areas.

After large scale treatments (plowing and seeding, prescribed burning, or mowing), follow-up livestock management practices such as rest from grazing or deferment of grazing are generally employed as standard operating procedure to promote and/or enhance native plant recovery. Most commonly used weed treatment methods (spot ground application of herbicides, hand-pulling, grubbing, or release of biological control insects) on the MBRTB do not require rest or deferment because they primarily target the weeds and have very little effect on desirable native plants or the treatments affect only a small area of native plants adjacent to, or among, the treated weeds.

Only the currently approved herbicides may be used under this alternative: chlorsulfuron, clopyralid, 2,4-D, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, and triclopyr. New herbicides would not be available. A restricted selection of approved herbicides means the broad-spectrum herbicides glyphosate, hexazinone, and imazapyr may be used more frequently. Broad-spectrum herbicides have more negative impacts to non-target vegetation in, and immediately adjacent to, treated weed patches.

Many native grasses and forbs eventually die out on a heavily infested cheatgrass site that remains untreated. They are unable to compete effectively for limited resources, especially moisture. On the Brush Creek/Hayden District, inspection of heavily infested cheatgrass sites revealed only a few native grasses and forbs that appear to persist long-term. Fringed sage (*Artemisia frigida*), herbaceous cinquefoils (*Potentilla* spp.), and bottlebrush squirreltail (*Elymus elymoides*) are the primary ones. Mature shrubs such as big sagebrush, bitterbrush, and serviceberry can persist in cheatgrass stands, but young replacement seedlings generally cannot become established.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

Under this alternative, manual, mechanical, cultural, biological, and chemical weed treatment methods would be used in combination to control, contain, or eradicate populations of weed species, and aerial herbicide application would be authorized. This alternative has more treatment methods and includes treatment of all new invasive plant species and the use of newly developed herbicides. It is estimated that between 3,000 and 8,000 acres would be treated annually.

Most herbicide application would be ground-based, but aerial application would be used on some large and/or remote weed infestations, primarily cheatgrass. Aerial application is anticipated on no more than 1,000-5,000 acres annually, with most of the treated acres located on the TBNG. Some years no aerial application would occur, depending on treatment needs, annual weather conditions, and available funding. Imazapic is the primary herbicide proposed for aerial application on the MBRTB. In the future, if suitable, selective, safe herbicides are developed and approved, they may also be aerially applied.

Aerial herbicide application under alternative 2 would facilitate cooperative treatments across ownership boundaries. As noted in the alternative 1 discussion, federal land managers have not participated in cooperative weed management efforts that spread across federal and private land because aerial application has not been available in the past.

About 2,000 to 3,000 acres of weed infestation would be treated annually using a combination of treatment methods other than aerial herbicide application. The most effective means for control and/or eradication would be chosen depending on the likelihood of long-term effectiveness or resource values at risk. The decision flow chart in figure 2 and guidelines in table 3 would guide treatment priority and methods, with emphasis generally being given to new invaders and species having the greatest risk of spread.

Effects of manual, mechanical, cultural, and biological treatments are discussed above in the *Effects Common to All Alternatives* section. Effects of herbicide use and aerial application of herbicides on invasive species and native vegetation are discussed below.

Effects on invasive species

This is the only alternative that attempts to address the proliferation of cheatgrass documented on the MBRTB since 2000. Without the ability to prevent or suppress cheatgrass invasion after a fire, the MBRTB has curtailed its prescribed fire program. This has negative consequences for shrubland and grassland plant communities where fire is an important tool for creating diversity in structural and successional stages. Cheatgrass control has both a direct and indirect benefit to big sagebrush/grass plant communities. The direct benefit is restoration of native plant species diversity. The indirect benefit is preventing a shift from a relatively long, natural fire return interval of 40 or more years to a short fire return interval of potentially 4-5 years, which could eventually eliminate big sagebrush over large areas and perpetuate a cheatgrass monoculture (Pellant 1996).

Herbicides provide the most cost effective and successful control of weeds in most instances, particularly for those species for which hand-pulling or other non-chemical treatment methods are largely ineffective or too damaging to native plant communities. Leafy spurge, yellow toadflax, Dalmatian toadflax, saltcedar, hoary cress, Russian olive, Canada thistle, field bindweed, oxeye daisy, Russian knapweed, squarrose knapweed, common tansy, perennial pepperweed, quackgrass, skeletonleaf bursage, medusahead, and cheatgrass are all species that are difficult or impossible to control using mechanical, biological, or cultural treatment methods (see appendix D for more information on effectiveness of various treatments by species).

Clopyralid is the most selective herbicide, affecting only plants in the sunflower (Asteraceae), buckwheat (Polygonaceae), nightshade (Solanaceae), and pea (Fabaceae) families. Sixteen of the thirty-four weed species of concern included in this analysis are in the sunflower and nightshade families.

Picloram and 2,4-D are effective on all species except grasses (Poaceae). DiTomaso et al. (2006) point out that continuous broadcast use of one or a combination of herbicides will often select for tolerant plant species. When broadleaf selective herbicides are used, noxious annual grasses such as cheatgrass may become dominant.

Imazapic, one of the 3 new herbicides proposed for use in this alternative, is effective on annual plants at low concentrations when applied as a pre-emergent to control cheatgrass, medusahead, and curveseed butterwort.

Effects on native vegetation

All of the herbicides considered in this analysis are likely to kill or damage some native plant species that are immediately adjacent to, or interspersed with, target weed species. Negative effects to native plants can be reduced by selecting the appropriate herbicide application method, rate, timing, and surfactant. All of the laws, regulations, standards, and guidelines that apply to herbicide use, as well as the protection measures in appendix A, minimize negative effects to native plant communities and other resources.

After large scale treatments (herbicide application, plowing and seeding, prescribed burning, or mowing), follow-up livestock management practices, such as rest from grazing or deferment of grazing, are generally employed to promote or enhance native plant recovery. Most commonly used weed treatment methods (spot ground application of herbicides, hand-pulling, grubbing, or release of biological control insects) on the MBRTB do not require rest or deferment because they primarily target the weeds and have very little effect on desirable native plants or the treatments affect only a small area of native plants adjacent to, or among, the treated weeds. For some herbicides such as imazapic, there may be few negative impacts or only light impacts to most native plant species at the recommended application rate for cheatgrass control on rangelands, so adjustments to livestock grazing may be minimal or unnecessary. Some treatment sites are so steep and rocky livestock cannot or do not utilize them, so livestock grazing adjustments are not needed.

Glyphosate is the least selective of the herbicides proposed for use. It would be used primarily for grounds and building maintenance situations where removal of all vegetation is required and native plant communities are not at risk. It may also be appropriate for limited shrubland and grassland applications if it is applied at low concentrations when most native species are not actively growing. Under those conditions, it does not affect all native species.

Monocots (grasses, grass-like plants, lilies, orchids and related families) are tolerant of dicamba because of rapid metabolism (Sheley and Petrof 1999).

Repeated clopyralid use over multiple years may have long-term detrimental effects on legume populations. Legume species are important components of rangelands, pastures, and wildlands, and are nearly as sensitive to clopyralid as yellow starthistle, one of the invasive plants clopyralid is used to control.

At higher concentrations, imazapic is a broad spectrum herbicide. Imazapic can damage or kill native grass, forb, and shrub species, especially if they are actively growing when the herbicide is applied. If applied early spring or fall when most perennials are dormant, it is most effective on the target annual weeds with fewer negative effects on native species.

Imazapic has been tested on some small, accessible cheatgrass infestations on the Brush Creek/Hayden District. Of the thirty-two native species recorded in the treatment area (eight shrubs, thirteen grasses/sedges, eleven forbs), three species were negatively affected by the herbicide: mountain brome (*Bromus marginatus*), Wood’s rose (*Rosa woodsii*), and wax currant (*Ribes cereum*). These plants were not killed but had stunted growth and yellowed leaves the spring following treatment. Other cheatgrass treatment trials with imazapic in Wyoming, Colorado, and Montana found variable native species response depending upon application rate, surfactant, timing, density of cheatgrass, amount of accumulated cheatgrass litter, and native species present (Ogg et al. 2003, Schoup 2003, Vollmer 2003, Rice and Sutherland 2006, Sebastian et al. 2003, Baker 2009).

At the appropriate rates for cheatgrass control in a rangeland setting, imazapic enhances vigor and production of many native plant species by releasing them from competition with cheatgrass for moisture and nutrients. In such instances, changes from the normal grazing system would not be needed. Where weed infestations are so dense that there are few native plants left or where the native plants are harmed by the treatment method used, revegetation by seeding would be needed. In such instances, rest or deferment from livestock grazing would be a critical part of the treatment prescription.

Aerial herbicide application is most likely to affect non-target native plants because this method applies herbicide to all plants in the treatment area, and drift can affect plants outside the treatment area. Protection measures in appendix A would minimize the risk of drift, and recent advances in computer-controlled aerial application technology allow more precise application in terms of the area where the herbicide is applied and the application rate. Spot applications with backpack sprayers, truck-mounted sprayers, or wick applicators would affect native vegetation less than aerial application because these ground-based methods target the weeds more precisely and limit treatment of adjacent non-target vegetation.

Alternative 3 (No Aerial Application of Herbicides) – Direct and Indirect Effects

Aerial application of herbicide would not be authorized under this alternative. All other weed management is the same as under alternative 2. Approximately 2,000-3,000 acres would be treated annually. The effects of mechanical, cultural, and biological treatment methods on weeds and native vegetation are discussed in the *Effects Common to All Alternatives* section. The effects of herbicide treatment and the adaptive management options are summarized below and compared with the effects of the other alternatives. See the effects discussion under alternative 2 for more information.

Lack of aerial treatment under this alternative would limit the MBRTB's opportunities to work with surrounding landowners for a landscape approach to invasive species management. Because aerial application has not been available in the past, federal land managers have not participated in cooperative weed management efforts across federal and private land. In some cases, the treatment projects could not be carried out without federal participation and had to be abandoned. In other instances, patches of federal land were left untreated in the midst of the treated areas, creating a weed seed source to re-infest the treated acres.

Effects on invasive species

Alternative 3 provides more effective weed control than alternative 1, much more effective weed control than alternative 4, and less effective control than alternative 2. Very little cheatgrass would be treated under alternative 3 because aerial application would not be available. Cheatgrass would be treated on a few areas using targeted grazing or ground application of imazapic, and it would likely increase in extent and density as a result.

Effects on native vegetation

This alternative would have a lower impact on native vegetation than alternative 1 because more selective herbicides are available. It would also have slightly less impact to native vegetation than alternative 2, because it does not include aerial herbicide application.

However, the ecological consequences of unchecked cheatgrass spread are likely to be very high for native grassland and shrubland communities on the MBRTB. Cheatgrass already occupies more acreage than all the other listed invasive species combined.

Most commonly used weed treatment methods (spot ground application of herbicides, hand-pulling, grubbing, or release of biological control insects) on the MBRTB do not require rest or deferment of livestock grazing because they primarily target the weeds and have very little effect on desirable native plants or the treatments affect only a small area of native plants adjacent to, or among, the treated weeds. For larger scale treatments (herbicide application, plowing and seeding, prescribed burning, or mowing), follow-up livestock management practices such as rest from grazing or deferment of grazing are generally employed to promote and/or enhance native plant recovery.

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

Under this alternative, only mechanical, cultural, and biological methods would be used to control weeds on the MBRTB. The effects of those treatment methods on weeds and native vegetation are discussed in the *Effects Common to All Alternatives* section. The acres of weeds treated would be much lower than under alternatives 1, 2, and 3. Approximately 500-1,200 acres would be treated annually, 60-75% less than are presently treated each year. There are several reasons for the decline in treated acres:

- There are no biological control agents for fourteen of the weed species of concern.
- Many of the biological control agents do not appear to be able to survive in the climate on the MBRTB.
- Most biological control agents only slow spread of the target weeds and do not reduce infestation size or eradicate them.
- There are insufficient resources (funding and personnel) to treat large weed patches with mechanical or cultural methods because the cost per acre is high. Mechanical control can cost two to four times as much as herbicide treatment, and fewer acres per day can be treated.
- If large weed patches were treated using mechanical or cultural methods, negative impacts to soils and/or native plant communities would be high.
- Biological characteristics of some weed species are such that mechanical, cultural, and biological controls are ineffective.

There would be little to no opportunity for cooperative treatment across ownership boundaries under this alternative given the limited treatment options available.

Effects on invasive species

Most weed populations would expand at an accelerated rate compared to alternatives 1, 2, and 3, and many would eventually achieve widespread distribution. The ecological consequences of such landscape scale transformations are enormous and have been documented for cheatgrass in the Great Basin and spotted knapweed in parts of Montana.

Under this alternative, there would likely be more aggressive use of biological control agents as they become available for use, because cultural and mechanical control techniques could only be used to treat a very small percentage of the existing weed-infested acres. Biological controls might reduce populations of some weeds but would not eradicate any weed species. Effectiveness of weed reduction or containment with biological controls is likely to vary widely by weed species and location and be ineffective for some species, as has been observed for biocontrol insects released since the 1990s.

Without the availability of herbicides, there would be little or no treatment of Russian olive or saltcedar, since mechanical control alone is largely ineffective. Both these invasive species can sprout from the stump after cutting. For mechanical control to be effective, the entire root system of these shrubs/trees would have to be dug out, a process that would be very damaging to native vegetation and would destabilize streambanks.

Effects on native vegetation

Overall, negative impacts to native plants are much greater if invasive species are not treated than if they are. Negative impacts to native plants from expanding weed populations would likely exceed any negative impacts caused by herbicide use under alternatives 1, 2, and 3. In many locations, but particularly in big sagebrush, mixed mountain shrub, and grassland plant communities, invasive species are likely to become dominant or co-dominant, resulting in loss of plant species diversity and corresponding habitat loss for native plants and animals.

Many native grasses and forbs eventually die out on a heavily infested cheatgrass site that remains untreated. They are unable to compete effectively for limited resources, especially moisture. On the Brush Creek/Hayden District, inspection of heavily infested cheatgrass sites revealed only a few native grasses and forbs that appear to persist long-term. Fringed sage (*Artemisia frigida*), herbaceous cinquefoils (*Potentilla* spp.), and bottlebrush squirreltail (*Elymus elymoides*) are the primary ones. Mature shrubs such as big sagebrush, bitterbrush, and serviceberry can persist in cheatgrass stands, but young replacement seedlings cannot become established.

The extent of cheatgrass infestations in the Great Basin and Upper Columbia River Basin and the ecological and economic impact of knapweeds in Montana illustrate the effects of invasive species proliferation on native plant communities. Pellant (1996) noted that over 79 million acres of public lands in eleven western states were either infested with cheatgrass or susceptible to invasion. He described the following impacts from the infestations: increase in the extent and frequency of wildfire in the Great Basin and Upper Columbia River Basin and loss of important big game winter range, habitat for nesting raptors, native sensitive plant species, nongame birds, and landscape diversity at both local and landscape scales.

On native bunchgrass sites in Montana, dense spotted knapweed populations reduce available winter forage for elk by 50 to 90 percent. Grazing capacities for livestock can be reduced 65 to 90 percent from original productivity. If spotted knapweed is allowed to spread to the fullest extent of its range, the estimated cost to Montana's agricultural industry will be $155 million each year (Sheley et al. 2005).

Most commonly used weed treatment methods (hand-pulling, grubbing, or release of biological control insects) on the MBRTB do not require rest or deferment of livestock grazing because they primarily target the weeds and have very little effect on desirable native plants or the treatments affect only a small area of native plants adjacent to, or among, the treated weeds. For larger scale treatments (plowing and seeding, prescribed burning, or mowing), follow-up livestock management practices such as rest from grazing or deferment of grazing are generally employed to promote and/or enhance native plant recovery.

Cumulative Effects

The following activities have potential to increase invasive species infestations and introduce new invasive species on the MBRTB: recreational use; livestock grazing; trail, road, and ditch maintenance; timber harvest; mineral exploration and development; energy development; fuels reduction; and wildlife habitat improvement projects. Weeds may be transported by people, livestock, water, or wind. As discussed earlier, the ecological consequences of not controlling invasive plant species, particularly cheatgrass, are likely to be very high for native grassland and shrubland communities on the MBRTB.

All alternatives reduce weed infestations on the MBRTB, but they differ in the acres that can be treated and the effectiveness of those treatments. With the potential for more acres treated, more effective treatment, and cooperative treatment across ownership boundaries, alternative 2 would help offset the effects of the past, present, and reasonably foreseeable future activities described above. This would be a cumulative benefit for native vegetation, particularly in areas with cheatgrass infestations.

Because they have fewer adaptive and integrated treatment options and fewer acres treated, alternatives 1 and 3 would not be as effective at offsetting the increase in invasive species from the activities listed above. In turn, they would provide a smaller cumulative benefit for native plant communities.

Alternative 4 would do little to offset the adverse effects of the activities listed above because it would be the least effective at controlling invasive species (limited treatment options and few acres treated). This would be a cumulative adverse impact on native plant communities since total acres infested by invasive species would likely increase across the MBRTB.

Forest Plan Consistency

Relevant forest and grassland plans standards and guidelines for native plant communities and weed species were reviewed for this project. The effects of the alternatives were evaluated to determine if they were consistent with this direction. Alternatives 1, 2 and 3 are consistent with forest and grassland plan direction. Alternative 4 is not consistent with the following guidelines in the Thunder Basin plan:

J. Noxious Weeds, Non-native, and Invasive Species

1. Manage invasive plant species using integrated management techniques, including mechanical, chemical, and biological control methods. Guideline

6. Utilize all methods feasible, including livestock grazing strategies in the integrated pest management program. Guideline

Issue #2: Threatened, Endangered, or Sensitive Species and Their Habitats (Plants and Wildlife)

A biological assessment and biological evaluation have been prepared for this project and can be found in the project record. The analysis and findings are summarized below.

Section 7 of the Endangered Species Act of 1973, as amended, requires federal agencies to insure actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of listed or proposed species, or result in the destruction or adverse modification of their critical habitats. This is documented in a biological assessment. The purpose of the biological assessment (BA) for this EIS is to inform the decision-maker and disclose the likely effects of the proposed action and alternatives on federally listed plant species (endangered, threatened, and proposed) (FSM 2670.31-2670.32). The results of the assessment are summarized in this section and available in full in the project record.

A biological evaluation is a documented Forest Service review of Forest Service actions in sufficient detail to determine how an action or proposed action may affect any threatened, endangered, proposed, or sensitive species (FSM 2670.5 – Definitions). A biological evaluation may be used to satisfy consultation requirements for a biological assessment (FSM 2672.4).

Threatened, Endangered and Sensitive Plants

Affected Area

The analysis area for threatened, endangered, and sensitive (TES) plants includes all vegetation communities near the proposed treatment areas or those habitats where weeds have potential to invade. These plant communities have the potential to be directly or indirectly impacted by weeds and proposed treatment methods.

Analysis Method

Occurrence records, habitat needs, and ecological requirements were derived Forest Service records and files, the Colorado Natural Heritage Program database, Wyoming Natural Diversity database, and published research. Information pertaining to species occurrence across the project area was also taken from the *Prefield Review for Threatened and Endangered, Sensitive and Local Concern Plant Species* (Roche and Proctor 2010). This document is included in the project record.

Affected Environment

A list of **threatened, endangered, proposed, and candidate plant species** was requested from the U.S. Fish and Wildlife Service on January 5, 2011. Three plants may occur in the project area (Sattleberg 2011): blowout penstemon (endangered), western prairie fringed orchid (threatened), and Ute ladies'-tresses (threatened).

Western prairie fringed orchid (*Platanthera praeclara*) and blowout penstemon *(Penstemon haydenii)* and their habitat are not found and are not likely to occur on the MBRTB. Western prairie fringed orchid was initially considered for analysis because it can be affected by water depletions to the Platte River watershed. Estimated water depletions associated with the project were well below the established threshold *de minimus* water depletion. Therefore, no alterations to downstream habitats would occur, and this species was excluded from analysis. Blowout penstemon was also excluded from further analysis because no impacts are expected from the project. There are no blowout penstemon occurrences or habitat in the project area.

Ute ladies'-tresses (*Spiranthes diluvialis)* is a perennial, terrestrial orchid found in relatively low elevation riparian, spring, and lakeside wetland meadows in three general areas of the interior western United States. Ute ladies'-tresses has not been documented anywhere on the MBRTB. The potential for suitable habitat was analyzed on the Thunder Basin National Grassland and in a few low-lying valleys in the Sierra Madre range and on the Routt National Forest. Habitat analysis and field surveys have determined that suitable habitat exists in select riparian areas on the Thunder Basin but suitable habitat is absent on the Sierra Madre range and the Routt NF. Multiple field surveys have been conducted on the Thunder Basin, but no populations of Ute ladies'-tresses have been discovered to date.

The invasion of exotic species into Ute ladies'-tresses habitat is thought to pose a serious threat to the species' viability (USFWS 1995, Heidel and Fertig 2007). It does not tolerate dense competing vegetation. Canada thistle (*Cirsium arvense),* Japanese brome (*Bromus japonicus)*, and other weedy species that commonly invade riparian areas may pose a threat. Herbicides may also pose a threat to this species. Research is limited, but it is likely that broad-leaf herbicide would damage or destroy Ute ladies'-tresses. It is not known how a selective herbicide, such as imazapic, might affect this species. Other threats to Ute ladies'-tresses include habitat loss, habitat modification, and over-collection.

The Forest Service **Region 2 sensitive species** list was updated by the regional forester on June 9, 2009. All R2 sensitive plant species that are known to occur or are suspected to occur on the MBTRB were considered in this analysis. The following table lists the sensitive plant species known or suspected to occur in the project area and their habitat preferences. The species are organized by occurrence and then grouped according to their preferred habitat or their growth habit (i.e., forbs/herbs, grasses, trees/shrubs) because protection measures may differ based on habitat, and the effects of the herbicides may vary depending on a plant's growth habit. For example, graminoids (grasses and grasslike plants) are generally not at risk from herbicides that target broadleaf plants (forbs/herbs).

The plants in the highlighted rows are particularly vulnerable because they are rare or have limited ranges or poorly understood habitat requirements. For three of the plants, a large percentage of known occurrences are on the MBRTB: Laramie columbine (majority of known global occurrences on the MBRTB), Barr's milkvetch (large percentage of Wyoming occurrences on the MBRTB), and Rabbit Ears gilia (a large percentage of known global occurrences on the MBRTB). Effects to these species are not expected to differ from other species, but the relative risk to species viability (not just individuals) is assumed to be greater.

Table 11. Sensitive plants known or suspected to occur in the project area.

Species	Habitat	Growth Habit
Occurs in the project area		
dwarf raspberry (nagoon berry) *Rubus arcticus ssp. acaulis*	In understory of moderate to dense canopy covers in spruce, spruce/willow, and occasionally willow dominated communities; also in boggy woods, marshes, mountain meadows and alpine tundra.	Forb/ Subshrub
autumn willow *Salix serissima*	Typically associated with areas of permanently saturated soils where peat is present.	Shrub, wetland species
sageleaf willow (hoary willow) *Salix candida*	In Wyoming, floating mats, bogs, fens and willow thickets around ponds on wet to saturated, histic soils, sometimes influenced by limestone. In Colorado, habitats are usually characterized as calcareous, rich or extremely rich fens.	
lesser panicled sedge *Carex diandra*	Floating and non-floating moss mats, pond edges, and hummocks in open shrub and sedge meadows at 6,100 to 9,700 feet.	Graminoid, wetland species
livid sedge *Carex livida*	Floating mats, bogs, fens and marls dominated by *Carex* species, often on wet hummocks.	
elliptic spike rush (boreal spike rush) *Eleocharis elliptica*	Seeps, springs, stock ponds, low gradient wetlands and wet meadows, adjacent to riparian areas.	
slender cottongrass *Eriophorum gracile*	Fens and subalpine wet meadows with saturated soils where vegetation is dominated by graminoids and forbs.	

Species	Habitat	Growth Habit
whitebristle cottongrass (altai cottongrass) *Eriophorum altaicum* var. *neogaeum*	Associated with water-saturated soils and occurs in the sub-alpine and alpine tundra zones (9,500 to 14,000 feet).	Graminoid, wetland species
lesser bladderpod *Utricularia minor*	Submerged in shallow ponds, lakes and slow-moving streams at 6,600 to 8,600 feet. Associated with montane fen ecological systems, beaver ponds, and small localized seeps at higher elevations in Colorado.	Forb, aquatic species
roundleaf sundew *Drosera rotundifolia*	Obligate wetland species that requires continuously moist or saturated soils and is found in sites with shallow water table depths.	Forb, wetland species
park milkvetch *Astragalus leptaleus*	Sedge-grass meadows, swales and hummocks, and among streamside willows.	
Kotzebue's grass of Parnassus *Parnassia kotzebuei*	Found in mesic to wet meadows, in wet, sandy lakeshores, wet mossy areas, thickets, along creeks, on wet slopes, dripping cliffs and moist tundra.	
Colorado tansyaster *Machaeranthera coloradoensis* var. *coloradensis*	Grows in sparsely vegetated areas on rocky, exposed soils of sedimentary or volcanic origin, in montane to alpine environments.	Forb
dropleaf buckwheat (slender leaved buckwheat) *Eriogonum exilifolium*	Habitat is semi-bare, sandy-clay gumbo flats, white shaley-gypsum ridges, red clay hills, and limestone outcrops in cushion plant-bunchgrass communities with low cover at 6,900 to 8,600 feet.	
Laramie columbine *Aquilegia laramiensis*	Occurs in shady, usually level microsites associated with granite outcrops and boulders.	
Barr's milkvetch *Astragalus barrii*	Found primarily on dry, sparsely vegetated rocky prairie breaks, knolls, hillsides and ridges on calcareous soft shale and siltstone or silty sandstone.	
Rabbit Ears gilia *Ipomopsis aggregata* ssp. *weberi*	Open sites with other herbaceous perennials in various vegetation cover types. Most commonly associated with sagebrush species.	
plains rough fescue (Hall's fescue) *Festuca hallii*	Montane meadows, slopes and edges of open coniferous woods and meadows at 6,800 to 11,000 feet. Usually found on soils derived from calcareous parent material.	Graminoid

Species	Habitat	Growth Habit
Occurrence suspected or suitable habitat present		
American cranberrybush (highbush cranberry) *Viburnum opulus* var. *americanum*	Moist wooded hillsides, thickets or low woodlands. Usually found adjacent to or in the vicinity of a reliable water source, but it is not restricted to wetland habitats.	Shrub, mesic sites[3]
Baltic sphagnum *Sphagnum balticum*	Hollows and floating mats in raised bogs and poor fens; low to high elevations.	Nonvascular, wetland species
sphagnum *Sphagnum angustifolium*	Wetland habitats from ombrotrophic to rich fens, open mires, sedge fens, and muskeg.	
simple bog sedge (kobresia) *Kobresia simpliciuscula*	Mesic to wet tundra, in shallow wetlands of glacial cirques, and in rich or extreme rich fens	Graminoid, wetland species
foxtail sedge *Carex alopecoidea*	Seasonally saturated meadows and openings in alluvial woods and stream banks, usually over calcareous substrates. Primarily found along open, perennial streams, often in or near old beaver dams or ponds.	
club spikemoss (northern spikemoss) *Selaginella selaginoides*	Wet places, mossy stream banks, lakeshores, fens and wet talus slopes, usually at low- to mid-elevations	Forb, mesic sites
Rocky Mountain monkeyflower *Mimulus gemmiparus*	Moist, seep areas, usually on ledges or under overhangs at the base of cliffs.	
white adder's-mouth orchid *Malaxis brachypoda*	Wetland sites, including bogs, mires, swamps, swales and wet meadows.	
narrowleaf moonwort *Botrychium lineare*	Primarily on limestone substrates in a variety of habitats including heavily forested sites and grassy meadows, fen-like seeps and gravelly roadsides. Past disturbance is an important factor for the establishment and persistence.	
trianglelobe moonwort *Botrychium ascendens*	Montane short and tall riparian willow communities with high moss, gravel, and cobble ground cover on volcanic or granitic alluvium at 8,000 to 9,000 feet. Disturbance is an important factor for establishment and persistence.	
Selkirk's violet *Viola selkirkii*	Moist, shaded ravines and cold boreal and hardwood forest habitats.	
Siberian sea thrift *Armeria maritima* ssp. *sibirica*	Grassy tundra slopes with wet, sandy, or spongy organic soils at 11,460 to 12,800 feet in Colorado.	
(forkleaved moonwort) *Botrychium furcatum*	Upper subalpine areas usually rocky or coarse textured soils. Disturbance is an important factor for establishment and persistence.	Forb
Harrington's beardtongue *Penstemon harringtonii*	Open sagebrush shrublands on gentle slopes between 6,400 and 9,400 feet.	

[3] Mesic sites have a moderate or well-balanced supply of moisture.

Species	Habitat	Growth Habit
Iowa moonwort (prairie moonwort) *Botrychium campestre*	Grasslands/mountain shrub communities, 3,700 to 10,800 feet. Calcareous soils underlain by limestone. Associated with little bluestem. Disturbance is an important factor for establishment and persistence.	Forb
peculiar moonwort *Botrychium paradoxum*	Montane to subalpine grasslands or forb-dominated meadows. Disturbance is an important factor for establishment and persistence.	
prairie dodder *Cuscuta plattensis*	Sand prairie hills at elevations of 4,200 to 4,900 feet. Known to be a parasite on *Grindelia*, *Solidago*, and *Helianthus*.	
clawless draba (Gray's peak draba) *Draba exunguiculata*	Fellfields and gravel or cobblestone soils on both steep and fairly flat slopes at elevations between 11,700 and 14,000 feet.	
Gray's draba *Draba grayana*	Rocky, gravel soils derived from granite, among granitic-gneiss boulders, on fellfields, and on talus slopes.	
ice cold buttercup *Ranunculus karelinii*	Dry, rocky alpine sites, including talus, scree, rock outcrops, fellfields, tundra, and ridgetops.	
rock cinquefoil (front range cinquefoil) *Potentilla rupincola*	Granite shelves or niches in cliffs. Sometimes found in sparsely forested sites with thin soil and in gravelly soils within, and adjacent to, rock outcrops.	
Occurrence historic or unconfirmed		
largeflower triteleia *Triteleia grandiflora*	Full sunlight to partial shade in meadows, grasslands, sagebrush, pinyon-juniper woodlands, aspen woodlands, pine forest, and scattered woodlands.	Forb
lesser yellow lady's slipper *Cypripedium parviflorum*	Shady deciduous and mixed woodlands near streams, shrublands, swamps, bogs, and wet forests. Most often found on predominantly calcareous soils.	
Visher's buckwheat (Dakota buckwheat) *Eriogonum visheri*	Gentle, rolling plains and hillocks of barren or semi-barren loamy, sandy clay, or clay soils derived from shale in dry steppe communities that experience a semiarid continental climate.	
common twinpod *Physaria didymocarpa* var. *lanata*	Unproductive range sites with shallow soil and outcrops. Soils vary greatly in texture and are generally well-drained.	

Environmental Effects

Alternative 4 and Effects Common to All Alternatives - Direct and Indirect Effects

Under all alternatives, the MBRTB would continue to integrate manual, mechanical, biological, and cultural treatments to slow the spread of invasive plants and eradicate some infestations. Since this is the proposed treatment approach for alternative 4 (no herbicide use), the effects are also discussed in this section. Appendix A contains resource protection measures to be implemented when doing manual, mechanical, biological, and cultural treatments.

The effects to rare plants associated with alternative 4 and common to all alternatives include direct and indirect effects associated with manual, mechanical, biological, and cultural treatments. The analysis assumes all relevant resource protection measures from appendix A would be applied. The analysis includes the beneficial effects of avoiding chemical herbicide use and the adverse effect of not adequately controlling the spread of weeds.

Manual and mechanical treatments are typically small scale and uncommon due to cost restraints. These treatments have the potential to damage plants and plant parts by pulling, crushing, burying, and removal or damage to above-ground biomass. Some plants respond favorably to mechanical treatments like haying, while others experience mortality or reduced vigor. Protection measures that insure survey and avoidance of rare plant species are designed to protect plants from these impacts.

In general, biological control agents are a low-risk treatment method because agents are not approved for use until they are subjected to rigorous screening to ensure they avoid non-target vegetation. However, even with the extensive testing, biological control is not risk-free. Biocontrol agents may also attack native (non-target) species, often those closely related to target species. Protection measures have been designed to restrict the use of biological control agents that may pose a threat to rare plants. Ute ladies'-tresses in particular is not closely related to any of the current weed species of concern on the MBRTB; thus, it is not likely to suffer impacts from biological control agents. However, there is still the risk that the biocontrol agents may cause indirect impacts by altering habitats and changing plant species composition.

Cultural methods such as seeding and grazing pose a minimal risk to rare plants. Some plant species are damaged by grazing while others respond with stimulated growth. The habitat for Ute ladies' tresses benefits from, and is maintained by, light grazing regimes. Seeding can cause problems if non-native or contaminated seed is used, but forest-level restrictions require the use of native plants and certified weed-free seed during seeding projects.

Alternative 4 provides less effective weed control than any of the other alternatives but poses the least risk to rare plants because herbicides would not be used and potential impacts from herbicides would be avoided. This alternative would have the least possibility of adverse impacts to Ute ladies'-tresses and habitat as a result of weed control treatments, but could have a greater possibility of adverse impacts as a result of weed population increases across the forest. The increase in abundance, extent, and diversity of non-native plants on the MBRTB as a result of no herbicide treatment and the possibility that these species may invade rare plant habitat would be an indirect adverse effect of this alternative.

Ute ladies'-tresses *(Spiranthes diluvialis):* The actions that would be implemented under alternative 4 would result in a determination of *may affect, not likely to adversely affect* for Ute ladies'-tresses. Lack of weed treatment would lead to expansion of most non-native species in extent and abundance, especially cheatgrass and Japanese brome, in areas of suitable habitat on the Thunder Basin National Grassland. Although not using herbicides would reduce adverse effects from treatment, lack of effective weed control could lead to habitat degradation for Ute ladies'-tresses over the long-term. It is thought that the threat of weed invasion in or near suitable habitat is equal to or greater than the risk of using herbicides, if resource protection measures are implemented. A biological assessment was prepared for all federally listed species expected to occur in the project area. The biological assessment discloses effects expected under all alternatives and is included in the project record.

Sensitive species: For most sensitive species, including the eight species listed below, the actions that would be implemented under alternative 4 would result in a determination of *may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.*

When implemented properly, manual, mechanical, biological, and cultural weed control can provide long-term beneficial effects for sensitive species. Alternative 4 also avoids the risk of adverse impacts from herbicide use. However, it would treat fewer invasive species and fewer acres of invasive species infestations than the other alternatives. As a result, sensitive plant species could be at risk from expanding weed populations. In particular, cheatgrass is expected to increase in extent and density under this alternative.

The risk of habitat degradation from cheatgrass expansion would be greater for some sensitive species because cheatgrass is more prevalent and has greater abundance in some habitats. The following sensitive species occur, or have habitat in, grassland and shrub communities of the prairie and foothills and could be most negatively affected by uncontrolled cheatgrass expansion:

Dropleaf buckwheat (known)	Harrington's beardtongue (suspected)
Rock cinquefoil (suspected)	Hall's fescue (known)
Barr's milkvetch (known)	Common twinpod (unconfirmed)
Colorado tansyaster (known)	Visher's buckwheat (unconfirmed)

A biological evaluation was prepared for all region 2 sensitive species expected to occur in the project area. The biological evaluation discloses effects expected under all alternatives and is included in the project record. A summary of the determinations of effects for all species is displayed in Table 13.

Alternative 1 (No Action) – Direct and Indirect Effects

The protection measures listed in appendix A apply to this alternative. They include strict herbicide spraying guidelines by chemical, TEP plant survey requirements, and protection measures for wetlands, water, and woodlands.

The effects associated with alternative 1 include the beneficial and adverse effects associated with manual, mechanical, biological, and cultural treatments discussed in the *Effects Common to all Alternatives* section plus the effects of herbicides applied using ground-based methods.

Direct impacts from the use of herbicides may be death or damage to plants caused by unintentional direct herbicide spray, herbicide drift, wind erosion of contaminated soils, or herbicide transport in water. Indirect effects include herbicide-caused death of pollinating insects.

Ground-based herbicide application often involves spraying roadsides and trails using motorized spraying equipment. It also includes using horse or backpack sprayers to treat more remote populations. Herbicide use and impacts are concentrated along roads and trails due to accessibility but also because travel corridors are often the site of the worst weed infestations. Herbicide use along roads could impact existing occurrences of roadside sensitive species. Because dropleaf buckwheat and Colorado tansyaster occur on road cuts and roadsides, use of herbicides for right-of-way management may be a threat (Anderson 2006a).

Herbicide drift has been found to adversely affect sensitive plants up to 10 meters from the application site, and wind-eroded soils can transport recently applied herbicides to new environments. The unintended movement of herbicides may cause foliar or reproductive damage to rare plants that may result in mortality. Protection measures to limit these affects are described in appendix A. The risk of unintended herbicide movement is lower with ground application of herbicide than with aerial application.

Herbicides that target broad-leaf invasive species would likely cause foliar and/or reproductive damage or plant mortality to the sensitive species with forb growth habits (see Table 11). Most of the sensitive plants on the MBRTB fall into this category. Those found in wetland areas would be protected by the measures mentioned above. However, the wet environments that support these species are not generally conducive to weed invasion.

Sensitive wetland species, such as elliptic spikerush, may be threatened by herbicide contamination of water bodies and streams adjacent to occupied wetlands. Doppler (2012) has shown that recently applied herbicide may be transported from point of origin to small depressions or surface water via overland flow from rain events. Since wetlands tend to occupy low spots and depressions on the landscape, especially on Thunder Basin National Grassland, it is possible herbicides may migrate to these areas during rain events.

Herbicides have been known to cause mortality in sensitive pollinators such as butterflies (LaBar and Schultz 2012, Stark et al. 2012) and damage habitat for native bees by decreasing larval food plants and safe sites (Moreby and Southway 1999). Most herbicides have been found to be non-toxic or minimally toxic to honeybees in acute toxicity tests (see appendix C of the *Biological Assessment and Biological Evaluation of Plant Species*), but cumulative or long-term exposure to multiple chemicals is thought to play a role in hive mortality (Kuldna et al. 2009, Potts et al. 2010, Fauser-Misslin et al. 2014). Use of herbicides to remove non-native species and the subsequent increase in native plant abundance has also been shown to benefit native pollinators, specifically native bees (Hanula and Horn 2011). Since most sensitive species are at least partially, if not completely, dependent on insect pollination to complete sexual reproduction, the enhancement or protection of pollinators and their habitats is an important component of sensitive species conservation.

Ute ladies'-tresses *(Spiranthes diluvialis):* The actions that would be implemented under alternative 1 would result in a determination of *may affect, not likely to adversely affect* for Ute ladies'-tresses. As discussed in the biological assessment (included in the project record), effects are expected to be insignificant (immeasurable and would not reach the level of take) or discountable (extremely unlikely to occur).

Resource protection measures (appendix A) have been designed to greatly reduce or eliminate potential adverse effects to Ute ladies'-tresses. These adverse effects to Ute ladies'-tresses from alternative 1 include mortality or damage from direct herbicide application or herbicide drift, herbicide contamination of occupied wetlands and adjacent water bodies, wind erosion of contaminated soils, or lowered reproduction rates due to pollinator mortality. Beneficial effects may include lowering competition from aggressive, non-native plants; improving pollinator habitat by increasing native plant diversity; or improving soil health by removing allelopathic weeds.

Potential adverse effects from herbicide use under alternative 1 would likely be less than under alternative 2 because ground-based herbicide applications typically treat smaller areas than aerial application. There may also be less beneficial effects because fewer acres and species are proposed for treatment.

Sensitive species: For most sensitive species, the actions that would be implemented under alternative 1 would result in a determination of *may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.* Determinations of effects have been made for all sensitive species. They are summarized in Table 13 and discussed in detail in the biological evaluation that is available in the project record.

The protection measures listed in appendix A would reduce the risk of adverse effects to sensitive species in the project area.

Less effective invasive species control under this alternative (compared to alternative 2, the preferred alternative) increases the chance that some invasive species could invade sensitive species habitat. Because there would be no aerial application of herbicide under this alternative, fewer acres of cheatgrass would be treated. The risk of habitat degradation from cheatgrass expansion is greater for some sensitive species because cheatgrass is more prevalent and has greater abundance in some habitats. Sensitive species that occur or have habitat in grassland and shrub communities of the prairie and foothills include Barr’s milkvetch, dropleaf buckwheat, Harrington’s beardtongue, Hall’s fescue, Colorado tansyaster, rock cinquefoil, common twinpod, and Visher’s buckwheat. The risk from herbicide use is also greater for some species, especially those with limited ranges or with a majority of global or state occurrences on MBRTB land: Barr’s milkvetch, Laramie columbine, and Rabbit Ears gilia.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

The protection measures in appendix A apply to this alternative, including an extensive list of protection measures for ground-based and aerial herbicide application. The protection measures include strict herbicide spraying guidelines by chemical and by application method; survey requirements for threatened, endangered, and proposed plants; and protection measures for wetlands, water, and woodlands.

The effects associated with alternative 2 include the beneficial and adverse effects associated with manual, mechanical, biological, and cultural treatments discussed in the *Effects Common to all Alternatives* section, the effects of herbicides applied using ground methods discussed under alternative 1, and the effects of newly approved herbicides and aerial application of herbicides discussed here.

This alternative allows the use of newly developed herbicides that have been registered with EPA. The potential effects of new herbicides would be similar to the effects of herbicides analyzed in this document because only herbicides with acceptable ecotoxicity ratings would be used. As described in the protection measures in appendix A, a forest herbicide assessment team would evaluate any new herbicide not analyzed in this EIS. The team would be comprised of a wildlife biologist, fisheries biologist, botanist, and invasive plant species treatment specialist. They would identify the ecotoxicity rating of the new herbicide based on the active ingredients and other relevant information. Additional NEPA analysis would be required for herbicides with ecotoxicity ratings different from those analyzed in this project.

The aerial application proposed in this alternative increases the number of acres that could be treated which could result in both adverse and beneficial effects. Initially, aerial application would use imazapic to treat cheatgrass on large infestations on the Thunder Basin National Grassland, on crucial big game winter ranges, and on previously burned areas on the MBR. Imazapic is a selective herbicide, and available information does not indicate adverse effects to the sensitive species. However, imazapic targets species in the same family as some sensitive species (such as the grass family Poaceae) and little research has been done on impacts to rare plant, so adverse effects remain possible.

With aerial application, coverage is broader than when using other methods and the total amount of herbicide used on a landscape is typically greater. This means the threat of water contamination through herbicide mobilization is also greater, and wetland species may be affected by selective herbicides applied to adjacent upland areas despite wetland and water body buffer zones. As described under alternative 1, rain events may transport the herbicide to small depressions, such as wetlands or surface water via overland flow (Doppler et al. 2012). This is more likely on the Thunder Basin National Grassland, where the topography of wetlands follows this description and where aerial application of herbicides will be used to the greatest extent. The risk of herbicide drift and wind erosion of contaminated soils is also greater. Herbicides have been found to drift up to 10 meters from the application site, and wind-contaminated sediments can travel up to ½ a mile. Resource protection measures (see appendix A) for aerial spraying minimize risk and create buffer zones around rare plants to help prevent adverse effects.

The risk to pollinators is also greater with aerial application of herbicides and could result in a decrease in cross-pollination and loss of population vigor for a number of sensitive species. Herbicides have been known to cause mortality in sensitive pollinators such as butterflies (LaBar and Schultz 2012, Stark et al. 2012) and damage habitat for native bees by decreasing larval food plants and safe sites (Moreby and Southway 1999). Most herbicides have been found to be non-toxic or minimally toxic to honeybees in acute toxicity tests (see appendix C of the *Biological Assessment and Biological Evaluation of Plant Species*), but cumulative or long-term exposure to multiple chemicals is thought to play a role in hive mortality (Kuldna et al. 2009, Potts et al. 2010, Fauser-Misslin et al. 2014). Use of herbicides to remove non-native species and the subsequent increase in native plant abundance has also been shown to benefit native pollinators, specifically native bees (Hanula and Horn 2011). Since most sensitive species are at least partially, if not completely, dependent on insect pollination to complete sexual reproduction, the enhancement or protection of pollinators and their habitats is an important component of sensitive species conservation.

Ute ladies'-tresses *(Spiranthes diluvialis):* The actions that would be implemented under alternative 2 would result in a determination of *may affect, not likely to adversely affect* for Ute ladies'-tresses. As discussed in the biological assessment (included in the project record), with resource protection measures in place, effects are expected to be insignificant (immeasurable, and would not reach the level of take) or discountable (extremely unlikely to occur).

Resource protection measures (appendix A) have been designed to greatly reduce or eliminate potential adverse effects to Ute ladies'-tresses. These adverse effects to Ute ladies'-tresses include mortality or damage from direct herbicide application or herbicide drift, herbicide contamination of occupied wetlands and adjacent water bodies, wind erosion of contaminated soils, or lowered reproduction rates due to pollinator mortality. Beneficial effects from the preferred alternative may take the form of lowering competition from aggressive, non-native plants; improving pollinator habitat by increasing native plant diversity; or improving soil health by removing allelopathic weeds.

Field surveys of suitable habitat prior to treatment may be the most important factor in detecting and protecting undiscovered Ute ladies'-tresses populations. Application of herbicides aerially or by using a boom sprayer would be restricted by limited and no-activity buffers near Ute ladies'-tresses populations if any are discovered. Buffers would vary in size depending on the herbicide used. Spot, wick, low boom, and backpack sprayer treatments with some herbicides would be allowed in the vicinity of Ute ladies'-tresses populations, as long as the activities are closely monitored and do not pose a threat. For herbicides that pose a risk to aquatic and wetland habitats, no-activity buffers would be used.

Sensitive species: The actions that would be implemented under alternative 2 would result in a determination of *may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing* for most species. However, the actions would result in a determination of *beneficial impact* for some species. Determinations of effects have been made for all sensitive species. They are summarized in Table 13 and discussed in detail in the biological evaluation that is available in the project record.

The protection measures listed in appendix A would reduce the risk of adverse effects to sensitive species in the project area.

The effects of biological, cultural, and mechanical weed treatments described for alternative 4 and herbicide effects described here and for alternative 1 apply to this alternative. The major differences are the options to use new, more effective or selective herbicides and the option for aerial application.

Laramie columbine is suspected to be particularly vulnerable to aerial treatments (Marriott and Porkorny 2006). This species is documented on Laramie Peak and suspected on Pole Mountain, and aerial spraying for cheatgrass is likely in both areas. The following protection measure for rare plants would help prevent adverse effects to Laramie columbine:

> “Weed infested sites must be evaluated for federally-listed threatened and endangered, and Forest Service regionally listed sensitive (TE&S) plants before treatment. A control plan will be developed to help protect any rare plants present. Crews and/or contractors will be provided maps of all known rare plant occurrences so the sites can be identified and protected. Crews will be trained to identify rare plants so that new sites can be identified and protected. The local botanist or designated resource specialist will be consulted prior to treating in the proximity of known rare plant populations."

Alternative 2 would be expected to have the greatest beneficial effects to sensitive species that occur in grassland and shrub communities of the prairie and foothills, including Barr’s milkvetch, dropleaf buckwheat, Harrington’s beardtongue, Hall’s fescue, Colorado tansyaster, rock cinquefoil, common twinpod, and Visher’s buckwheat. These communities would be treated for the control of cheatgrass, which could make significant long-term improvements in grassland and shrub habitats. Alternative 2 would also pose the greatest threat of short-term adverse impacts if selective herbicides unintentionally damage or destroy any of these or other sensitive plant species. Effects of selective herbicide on sensitive species, although presumed low, have not been studied in detail.

Alternative 3 (No Aerial Application) – Direct and Indirect Effects

The protection measures in appendix A apply to this alternative. The protection measures include strict herbicide spraying guidelines by chemical, TEP plant survey requirements, and protection measures for wetlands, water, and woodlands.

The effects associated with alternative 3 include the beneficial and adverse effects associated with biological, cultural, and mechanical treatments discussed in the section *Effects Common to All Alternatives*, the effects of herbicides applied using ground-based methods discussed under alternative 1, plus the effects of newly approved herbicides discussed for alternative 2.

Ute ladies’-tresses *(Spiranthes diluvialis):* The actions that would be implemented under alternative 3 would result in a determination of *may affect, not likely to adversely affect* for Ute ladies’-tresses. As discussed in the biological assessment (included in the project record), effects are expected to be insignificant (immeasurable, and would not reach the level of take) or discountable (extremely unlikely to occur).

Resource protection measures (appendix A) have been designed to greatly reduce or eliminate potential adverse effects to Ute ladies’-tresses. Because newly developed and potentially more selective herbicides may be used, alternative 3 would likely have a somewhat lower risk of direct herbicide impact to Ute ladies’-tresses than alternative 1. It would also have slightly less risk of direct herbicide impact than alternative 2, because it does not include aerial herbicide application which would cover more acreage, carries a risk of drift and water contamination, and may effect a large population of pollinators.

Beneficial effects to Ute ladies'-tresses habitat from invasive species eradication or control could still occur. Alternative 3 would provide more effective weed control than alternative 1 and alternative 4 and less effective control than alternative 2. Effectiveness of weed control has an indirect impact on Ute ladies'-tresses as less effective control increases the chance that invasive species would invade suitable habitat.

Sensitive species: Due to risks and benefits of herbicide use and the threat of cheatgrass expansion under this alternative, the actions that would be implemented under alternative 3 would result in a determination of *may adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing* for most sensitive species. The determinations are summarized in Table 13 and discussed in detail in the biological evaluation that is available in the project record.

The protection measures listed in appendix A would reduce the risk of adverse effects to sensitive species in the project area.

Weed management under this alternative is the same as under alternative 2 except that aerial application of herbicide would not be authorized. Because more selective herbicides are available, this alternative would likely have somewhat lower direct herbicide impact on sensitive species than alternative 1. It is would also have slightly less direct herbicide impact on sensitive species than alternative 2, because it does not allow aerial herbicide application, which allows treatment of more acres and carries some risk of drift.

Cheatgrass is expected to increase in extent and density under this alternative because very little treatment would occur without aerial application. As mentioned under alternative 1, cheatgrass invasion is a conservation concern for Barr's milkvetch, dropleaf buckwheat, Harrington's beardtongue, Hall's fescue, Colorado tansyaster, rock cinquefoil, common twinpod, and Visher's buckwheat. Expansion of cheatgrass constitutes a high risk for the persistence of these and other rare plant species. The threat of aerially applied herbicides to Laramie columbine would be eliminated under this alternative.

Cumulative Effects to Ute ladies'-tresses under ESA

The cumulative effects analysis for Ute ladies'-tresses only considered future non-federal activities that are reasonably certain to occur in the action area as required by the Endangered Species Act (ESA). Future federal activities or activities permitted by federal agencies were not included because activities that may adversely affect threatened or endangered species must undergo consultation with the U.S. Fish and Wildlife Service, pursuant to section 7 of the ESA.

Identified threats to Ute ladies'-tresses include habitat loss and modification through urbanization, water development, and conversion of wetlands to agriculture; over collection; competition from exotic weeds; herbicides (USFWS 1992); vegetation succession; road and other construction; hydrologic change; grazing (domestic livestock and wildlife); recreation; flooding; haying/mowing; loss of pollinators; and drought (Fertig et al. 2005). Of these, competition from invasive species and vegetation succession are the greatest threat to existing populations of Ute ladies'-tresses (Fertig et al. 2005).

The preferred alternative (alternative 2) may contribute adverse cumulative effects to Ute ladies'-tresses rangewide if undiscovered populations are damaged by herbicides or pollinator loss. Adverse effects would be mitigated by the protection measures (e.g., pre-treatment surveys, no-activity and limited-activity buffers for riparian areas and wetlands) in appendix A.

Because invasive species are an identified threat to Ute ladies'-tresses, the preferred alternative may beneficially contribute to the species by reducing cheatgrass and restoring habitats to native vegetation. This would offset adverse effects from the activities listed above.

Ute ladies'-tresses have not been found on the MBRTB despite extensive field surveys; however, suitable habitat is present.

Cumulative Effects to Sensitive Plants

The temporal boundary for the effects analysis is 10 years into the past and 10 years into the future, which is an adequate length of time to record vegetation changes. The spatial boundary is the MBRTB. The following table lists past, present, and reasonably foreseeable future actions and their potential effects on sensitive plants.

Table 12. Past, present, and reasonably foreseeable future actions considered in the effects analysis for threatened, endangered, and sensitive plants.

Action	Potential Effects
Livestock grazing	Trampling, compacting soils, changing plant composition, causing downcutting and degradation of streams and subsequent drying of adjacent meadows, and introducing invasive species.
Timber harvest and thinning	Increasing the amount of light reaching the forest floor, disturbing and compacting soils, and introducing invasive species. Increases recreation effects by improving access. These activities are increasing on the MBRTB in response to the mountain pine beetle epidemic.
Motorized and nonmotorized recreation use	Soil disturbance, compaction, and erosion and introducing invasive species.
Road and trail construction and maintenance	Soil disturbance and erosion, fragmenting and destroying habitat, introducing invasive species. Increases recreation effects by improving access.
Wildfire fire suppression	Soil disturbance, compaction, and erosion and introducing invasive species.
Prescribed fire	Creates or improves habitat for select plant species by opening up meadows and /or reducing the litter accumulation and competition from other plants. Could also burn plants or their habitat, sterilize the soil, and eliminate fungal species that are necessary for the survival of others.
Mining	Habitat destruction, introducing invasive species.
Urban development	Destroys habitat, fragments populations, and increases the risk of weed invasion and fire.

The cumulative effects from alternatives 1, 2, 3, and 4 are not expected to contribute to a change in status or viability for sensitive plant species. However, three known sensitive species are more vulnerable to cumulative effects because they have limited ranges: Laramie columbine, Barr's milkvetch, and Rabbit Ears gilia.

All of the activities in the table above have the potential to introduce invasive species which can threaten sensitive plant species and their habitat as discussed earlier. Alternatives 2, 3, and 1 would reduce this threat to some degree because they allow herbicide treatment of invasive species. While there is potential for damage from the herbicides, the protection measures in appendix A would reduce the risk of damage to sensitive plants and their habitats. Alternative 4 would be much less effective at reducing the cumulative threat from invasive species infestation because treatment is limited to manual, mechanical, biological, and cultural treatments which have limited ability to eliminate or control invasive species.

Other potential effects (soil compaction, habitat destruction, habitat fragmentation) from projects with discrete ground-disturbing actions (e.g., timber harvest, road construction) may be mitigated by including forest plan direction for sensitive plants in project design. Alternatives 2, 3, and 1 could help decrease any potential adverse effects to sensitive plants by reducing existing invasive species infestations and controlling new ones. Protection measures in appendix A would add to the protection from forest plan standards and guidelines. This would help offset the potential adverse effects from herbicide use in these alternatives.

Livestock grazing and recreation may have adverse effects on sensitive plants and habitat as described in the table above. Unlike timber harvest and road construction, for example, grazing and recreation occur across the landscape so surveying for sensitive plant occurrences and then avoiding them is not an option.

Determination of Effects

A summary of the determination of effects for threatened, endangered, and sensitive species is included in the table below. An explanation of the acronyms follows the table. The biological assessment and biological evaluation completed for these species are included in the project record and include species accounts, more detailed effects analysis, and rationale for the determinations.

Table 13. Summary of determination of effects for threatened, endangered, and sensitive plants.

Name	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Determination	Determination	Determination	Determination
Threatened				
Ute ladies'-tresses *Spiranthes diluvialis*	NLAA[1]	NLAA[1]	NLAA[1]	NLAA[1]
Sensitive				
Laramie columbine *Aquilegia laramiensis*	MAII	MAII**	MAII	MAII
Siberian sea thrift *Armeria maritima* ssp. *sibirica*	MAII	MAII	MAII	MAII
Barr's milkvetch *Astragalus barrii*	MAII	BI	MAII	MAII
park milkvetch *Astragalus leptaleus*	MAII	MAII	MAII	MAII
trianglelobe moonwort *Botrychium ascendens*	MAII	MAII	MAII	MAII
Iowa moonwort (prairie moonwort) *Botrychium campestre*	MAII	MAII	MAII	MAII
forkleaved moonwort *Botrychium furcatum*	MAII	MAII	MAII	MAII
narrowleaf moonwort *Botrychium lineare*	MAII	MAII	MAII	MAII

Name	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Determination	Determination	Determination	Determination
peculiar moonwort *Botrychium paradoxum*	MAII	MAII	MAII	MAII
foxtail sedge *Carex alopecoidea*	MAII	MAII	MAII	MAII
lesser panicled sedge *Carex diandra*	MAII	MAII	MAII	MAII
livid sedge *Carex livida*	MAII	MAII	MAII	MAII
prairie dodder *Cuscuta plattensis*	MAII	MAII	MAII	MAII
lesser yellow lady's slipper *Cypripedium parviflorum*	MAII	MAII	MAII	MAII
clawless draba (Gray's peak draba) *Draba exunguiculata*	MAII	MAII	MAII	MAII
Gray's draba *Draba grayana*	MAII	MAII	MAII	MAII
roundleaf sundew *Drosera rotundifolia*	MAII	MAII	MAII	MAII
elliptic spike rush (boreal spike rush) *Eleocharis elliptica*	MAII	MAII	MAII	MAII
dropleaf buckwheat (slender leaved buckwheat) *Eriogonum exilifolium*	MAII	BI	MAII	MAII
Visher's buckwheat (Dakota buckwheat) *Eriogonum visheri*	MAII	BI	MAII	MAII
whitebristle cottongrass (altai cottongrass) *Eriophorum altaicum* var. *neogaeum*	MAII	MAII	MAII	MAII
slender cottongrass *Eriophorum gracile*	MAII	MAII	MAII	MAII
plains rough fescue (Hall's fescue) *Festuca hallii*	MAII	MAII	MAII	MAII
scarlet gilia (Rabbit Ears gilia) *Ipomopsis aggregata* ssp. *weberi*	MAII	MAII	MAII	MAII
simple bog sedge (kobresia) *Kobresia simpliciuscula*	MAII	MAII	MAII	MAII
Colorado tansyaster *Machaeranthera coloradoensis* var. *coloradensis*	MAII	BI	MAII	MAII
white adder's-mouth orchid *Malaxis brachypoda*	MAII	MAII	MAII	MAII
Rocky Mountain monkeyflower *Mimulus gemmiparus*	MAII	MAII	MAII	MAII
Kotzebue's grass of Parnassus *Parnassia kotzebuei*	MAII	MAII	MAII	MAII
Harrington's beardtongue *Penstemon harringtonii*	MAII	MAII	MAII	MAII
common twinpod *Physaria didymocarpa* var. *lanata*	MAII	BI	MAII	MAII
rock cinquefoil (Front Range cinquefoil) *Potentilla rupincola*	MAII	BI	MAII	MAII

Name	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Determination	Determination	Determination	Determination
ice cold buttercup *Ranunculus karelinii*	MAII	MAII	MAII	MAII
dwarf raspberry (nagoon berry) *Rubus arcticus* ssp. *acaulis*	MAII	MAII	MAII	MAII
sageleaf willow (hoary willow) *Salix candida*	MAII	MAII	MAII	MAII
autumn willow *Salix serissima*	MAII	MAII	MAII	MAII
club spikemoss (northern spikemoss) *Selaginella selaginoides**	NI	NI	NI	NI
sphagnum *Sphagnum angustifolium*	MAII	MAII	MAII	MAII
Baltic sphagnum *Sphagnum balticum*	MAII	MAII	MAII	MAII
largeflower triteleia *Triteleia grandiflora*	MAII	MAII	MAII	MAII
lesser bladderpod *Utricularia minor*	MAII	MAII	MAII	MAII
American cranberrybush (highbush cranberry) *Viburnum opulus* var. *americanum*	MAII	MAII	MAII	MAII
Selkirk's violet *Viola selkirkii*	MAII	MAII	MAII	MAII

[1]**Determination of effect codes for federally listed species: NE**=No effect, **NLAA**=May affect, not likely to adversely affect, **BE**=May affect, beneficial**, LAA**=May affect, likely to adversely affect.

Determination of effect codes for sensitive species: NI=No impact; **BI**=Beneficial impact; **MAII**=May adversely impact individuals, but not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing; **LFL**=Likely to result in a loss of viability in the Planning Area, or in a trend toward federal listing.

*****Species not known to occur in the project area and not likely to be discovered in the future due to habitat changes and loss, records for these species are historic and not relocated or non-existent.

** Due to high sensitivity to aerially applied herbicides, protection measures must be implemented thoroughly to avoid a determination of LFL.

Forest Plan Consistency

Relevant standards and guidelines for the forest and grassland plans were reviewed. The effects of the four alternatives and the protection measures in appendix A were evaluated to determine if they were consistent with forest and grassland plan direction. The alternatives meet the standards and guidelines when the resource protection measures in appendix A are applied.

Wildlife Resources (Federally Listed Species, Sensitive Species, Management Indicator Species, and Other Species of Concern)

Analysis Method, Assumptions, and Limitations

Herbicide fact sheets (US DOE 2000a-k and 2006a-b) and ecological risk assessments (SERA 2004a-f, 2005, 2006, 2007, 2009, 2011a-d) were used to complete this analysis and evaluate toxicity of herbicides on mammalian and avian wildlife species. The risk assessments and herbicide fact sheets relate the expected direct effects of exposure and ingestion. They do not address the indirect effects of habitat alteration.

The risk characterizations for both mammal and bird species are limited by the relatively few animal species on which data are available compared to the large number of species that could potentially be exposed. The majority of the information comes from experimental animals such as mice, rats, dogs, mallards, or quail and is extrapolated to mammal or bird species in general. This limitation and consequent uncertainty is common to most, if not all, ecological risk assessments.

Risk levels for herbicide use are calculated in a very conservative manner, and worst-case exposure scenarios have been studied for most herbicides. Lethal dose 50 (LD50) values are used as a measure of toxicity and are defined as the quantity of chemical per unit body weight that would cause lethal effects in 50% of a study population with a single dose. Reported LD50 values for herbicides were sometimes highly variable, reflecting differences among studies such as use of different species or exposure techniques, varying sample sizes, etc. Despite this variability, data are sufficient to determine that the herbicides proposed for use under the preferred alternative are generally of low toxicity to mammals and birds.

Affected Environment

Threatened, endangered, or proposed species

In 2011, the U.S. Fish and Wildlife Service (USFWS) provided the MBRTB a comprehensive list of listed, proposed, candidate, petitioned species, and designated and proposed critical habitat. USFWS also requested that migratory birds, raptors, and bald and golden eagles be addressed. The following table lists the terrestrial wildlife species that were identified. It also includes species that have had a status change since 2011 (e.g., recent listings, proposed, or petitioned species). Species in the shaded rows were excluded from further analysis as discussed in the section following the table. Greater sage-grouse and mountain plover are discussed in the *Region 2 sensitive species* section.

Table 14. USFWS threatened, endangered, proposed, candidate, petitioned terrestrial wildlife species and designated and proposed critical habitat.

Common Name	*Scientific Name*	Habitat
Canada lynx (threatened)	*Lynx canadensis*	Montane forests (MBNF, RNF)
Preble’s meadow jumping mouse* (threatened)	*Zapus hudsonius preblei*	Montane riparian (TBNG, MBNF)
Greater sage-grouse, (candidate)	*Centrocercus urophasianus*	Sagebrush communities (MBNF, RNF, TBNG)
Mountain plover* (R2 sensitive)	*Charadrius montanus*	Grasslands and prairie dog towns (TBNG)
North American wolverine*	*Gulo gulo luscus*	Boreal forests and alpine (MBNF, RNF)

Common Name	*Scientific Name*	Habitat
Northern long-eared bat*	*Myotis septentrionalis*	Winter roost-caves, mines; Maternal roost-mature old forests, ponderosa pine (TBNG)
Red knot*	*Calidris canutus rufa*	No occurrence or rare migrant: (MBRTB)
Sprague's pipit*	*Anthus spragueii*	Native prairie (no occurrence: TBNG
Yellow-billed cuckoo*	*Coccyzus americanus*	Possible habitat, no known occurrence (MBNF, RNF)
Platte River species: Interior least tern Piping plover Whooping crane	 *Sternula antillarum* *Charadrius melodus* *Grus americana*	Downstream riverine habitat of the Platte River system (No occurrence: MBNF, RNF, TBNG)
Platte River species critical habitat	Designated for whooping crane in Nebraska in riverine habitat of the Platter River system (see 50 CFR 17.95(b); Not found on MBNF, RNF, TBNG)	
* Species with status change since March 2011.		

Source: USFWS 2011, 2013

Canada lynx (threatened): The MBRTB maintains a geographic information system (GIS) database of documented special status species observations on the forest. Eight observations of lynx were documented from 1905 through 2002. Three occurred prior to 1912, the remaining five after 1992. Habitat for the Canada lynx exists within treatment areas and has potential to be impacted by the proposed invasive species treatments. The Canada lynx was analyzed further (see discussion in the *Environmental Effects* section).

Habitat for the **Preble's meadow jumping mouse** (threatened) exists within treatment areas and has potential to be impacted by the proposed invasive species treatments. Although the range of Preble's meadow jumping mouse has not been well defined due to difficulties in distinguishing between *Zapus* species in the field and areas of sympatry (Bowe and Beauvais 2012), most occurrences are along the foothills of the Rocky Mountains from the Laramie Range in Wyoming to Colorado Springs, CO. The crest of the Laramie Mountain Range is considered the western boundary of the Preble's meadow jumping mouse in Wyoming (Smith et al. 2004). No critical habitat has been designated for this species within the MBRTB at this time. Habitat loss and degradation due to human disturbances and increasingly intense fires create a challenge for this species as their populations are isolated and their mobility is limited. The Preble's meadow jumping mouse was analyzed further (see discussion in the *Environmental Effects* section).

Greater sage-grouse is recognized as a candidate species. It is also a Region 2 sensitive species and management indicator species (MIS) and is discussed in the *Region 2 sensitive species* section below.

In May 2011, the USFWS withdrew the proposed rule to list the **mountain plover** as threatened. The mountain plover is a Region 2 sensitive species and is discussed in the *Region 2 sensitive species* section below.

The **North American wolverine** in the western United States was accorded candidate status on December 14, 2010 (FR 75:78030 – 78061) and was included in the 2011 USFWS letter as a candidate. Threats to the wolverine are loss of habitats with persistent snow cover as a result of climate change and increasing temperatures. Dispersed recreation activities, infrastructure development, transportation corridors, and land management activities do not pose a threat to the species. The activities proposed in this project were reviewed, and it has been determined that "*the preferred alternative is not likely to jeopardize the continued existence of the wolverine*". No conferencing with USFWS was necessary since the project will not jeopardize the continued existence of the wolverine. The wolverine was excluded from further analysis.

Project activities that pose a threat to the **northern long-eared bat** are prescribed burning and aerial herbicide treatments during maternal roosting in summer time. Incorporating the following resource protection measures would result in a determination of *not likely to jeopardize the continued existence of the long-eared bat*:

> No prescribed burning or aerial herbicide treatments in suitable habitat (e.g., ponderosa pine) during May 1-Aug 30 in the following counties: Campbell, Crook, and Weston (spp. range in WY) or mandatory surveys will be completed prior to implementation and no occurrences documented.

No conferencing with USFWS was necessary since the project will not jeopardize the continued existence of the long-eared bat. The long-eared bat was excluded from further analysis.

The USFWS includes **Platte River species** on the list for the MBRTB depending on whether the preferred alternative may lead to consumptive use of water or have the potential to affect water quality in the Platte River system. No water depletions are expected. The herbicides proposed under this EIS must be approved by the Environmental Protection Agency, thus no affects to water quality are expected. The determination for the interior least tern, piping plover, and whooping crane is *no effect*. The invasive species treatments do not occur in designated critical habitat for Platte River species (i.e., whooping crane), thus "*the preferred alternative will not result in destruction or adverse modification of designated critical habitat for the whooping crane*". The Platte River species were excluded from further analysis.

The **rufa red knot** was listed as a proposed threatened species by the USFWS on September 30, 2013 (FR 78: 60023-60098). This species is a rare migrant and it is not anticipated that the proposed action will pose any threats to the rufa red knot. Therefore, it has been determined that *the preferred alternative is not likely to jeopardize the continued existence of the rufa red knot*. No conferencing with USFWS was necessary, and this species was excluded from further analysis.

Sprague's pipit is currently listed as a candidate species by the USFWS (FR 77: 69994-70060). This species' range does not overlap with Medicine Bow-Routt NF and Thunder Basin NG. The Thunder Basin NG is dominated by sagebrush habitats that are not preferred by the Sprague's pipit. Therefore, the Sprague's pipit was excluded from further analysis since *no impacts to Sprague's pipit are anticipated*.

The distinct population segment of the **yellow-billed cuckoo** west of the Continental Divide was recently proposed for listing under the ESA as a threatened species (78 FR 61621; October 3, 2013). These cuckoos typically nest below 6,000 feet; however nesting has been confirmed in Craig, CO with the closest occurrence to the MBR documented just outside of Hayden, CO. With the following protection measure, this project would not degrade communities of cottonwood, riparian habitats and would avoid impacting yellow-billed cuckoos:

> No prescribed burning, herbicide, mechanical or aerial herbicide treatments in suitable habitat (e.g., cottonwood, riparian habitats) during June 1-Aug 30 or mandatory surveys will be completed prior to implementation and no occurrences documented.

With the protection measure, it has been determined that "*the preferred alternative is not likely to jeopardize the continued existence of the yellow-billed cuckoo*". No conferencing with USFWS was necessary, and the yellow-billed cuckoo was excluded from further analysis.

Region 2 sensitive species

The following table lists the Region 2 sensitive wildlife species. Forest wildlife observation files (NRIS Wildlife), Wyoming Natural Diversity database records, and Wyoming Game and Fish Department records were used to evaluate species presence in the analysis area. Potential wildlife habitat was evaluated using the Region 2 vegetation geodatabase (R2Veg). Species with individuals or habitat in the analysis area were evaluated to determine if implementation of the alternatives would result in direct, indirect, or cumulative impacts. Species in the shaded rows are not present in the analysis area or do not have habitat in the analysis area; they were not analyzed further.

Table 15. Region 2 sensitive species considered for analysis.

Common Name	Scientific Name	Detailed Analysis
Greater sage-grouse	*Centrocercus urophasianus*	Yes
Swift fox	*Vulpes velox*	Yes
Rocky Mountain bighorn sheep	*Ovis canadensis canadensis*	Yes
Black-tailed prairie dog	*Cynomys ludovicianus*	Yes
Northern harrier	*Circus cyaneus*	Yes
Ferruginous hawk	*Buteo regalis*	Yes
Bald eagle	*Haliaeetus leucocephalus*	Yes
Grasshopper sparrow	*Ammodramus savannarum*	Yes
Loggerhead shrike	*Lanius ludovicianus*	Yes
Mountain plover	*Charadrius montanus*	Yes
Burrowing owl	*Athene cunicularia*	Yes
Chestnut-collared longspur	*Calcarius ornatus*	Yes
McCown’s longspur	*Calcarius mccownii*	Yes
Columbia sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	Yes
Sage sparrow	*Amphispiza belli*	Yes
Short-eared owl	*Asio flammeus*	Yes
Brewer’s sparrow	*Spizella breweri*	Yes
Pygmy shrew	*Sorex hoyi montanus*	No
Fringed myotis	*Myotis thysanodes*	No
Townsend’s big-eared bat	*Plecotus townsendii*	No
Hoary bat	*Lasiurus cinereus*	No
Wyoming pocket gopher	*Thomomys clusius*	No
American marten	*Martes americana*	No
Wolverine	*Gulo gulo*	No
River otter	*Lontra canadensis*	No
Northern goshawk	*Accipiter gentilis*	No
American peregrine falcon	*Falco peregrinus anatum*	No
White-tailed ptarmigan	*Lagopus leucurus*	No
Boreal owl	*Aegolius funereus*	No
Flammulated owl	*Otus flammeolus*	No
Black swift	*Cypseloides niger*	No
Lewis woodpecker	*Melanerpes lewis*	No

Common Name	Scientific Name	Detailed Analysis
Black-backed woodpecker	*Picoides arcticus*	No
Olive-sided flycatcher	*Contopus cooperi*	No

Greater sage-grouse are dependent on sagebrush for much of their food and cover requirements throughout the year (Connelly et al. 2011). They are considered a landscape species and conservation of the species and their habitats is important to the sagebrush ecosystem (Wyoming Sage Grouse Working Group 2003). Current threats are largely due to loss of suitable sagebrush habitat through conversion, degradation, and fragmentation (Knick and Connelly 2011) and the emergence of West Nile virus (Naugle 2004).

Bald eagles are typically associated with aquatic habitats and primarily feed on fish or carrion. Nests are usually constructed in the dominant or co-dominant tree of a stand (Johnsgard 1990). Wintering eagles tend to aggregate at roosting sites, often where food concentrations are higher.

Ferruginous hawk: This large raptor is found throughout TBNG in appropriate habitat. Many individuals migrate south of TBNG in the winter; however, recent telemetry information shows individual hawks collared on TBNG remain through the winter. The primary threat to ferruginous hawks is the loss and conversion of historically occupied habitat which alters nesting habitat and foraging resource availability (Collins and Reynolds 2005).

Short-eared owls migrate south in the winter; however, some birds will overwinter on the TBNG. The project area provides foraging habitat, but because of the rolling topography and the adjacent ponderosa pine, the area is not nesting habitat.

Burrowing owls are summer residents on TBNG where they forage for insects and small vertebrates. They are most often associated with prairie dog colonies. McDonald and others (2004) identified the three primary threats to burrowing owls as habitat loss/fragmentation, anthropogenic sources, and losses on wintering grounds.

Mountain plover is a summer breeder on TBNG and is most often found in prairie dog colonies where the shortgrass habitat it prefers is maintained. Dinsmore (2003) identified loss of native habitat, including prairie dog colonies, as the primary threat to mountain plover.

McCown's longspurs are summer breeders on TBNG, and they winter in Texas and Oklahoma (Sedgwick 2004b). They are a ground-nesting species that forages for insects and seeds. The primary threat to this species is the loss of native shortgrass prairie habitat (Sedgwick 2004b).

Chestnut-collared longspurs are summer breeders on TBNG in areas of shortgrass and mixed-grass habitat. Wintering habitat is the southwest United States into Texas. They are a ground-nesting passerine that forages for insects and seeds. The primary threats to this species are habitat loss and conversion (Sedgwick 2004a).

Loggerhead shrikes are most likely to be found at lower elevations on NFS lands in Wyoming. They are observed primarily in open habitats with scattered perching sites. In the Rocky Mountains, this species ranges in elevation from agricultural lands on the prairies to montane meadows. Loggerhead shrikes nest in sagebrush areas, desert scrub, pinyon-juniper woodlands, and woodland edges.

Brewer's sparrows breed in Wyoming and winter in northern Mexico. They depend on large intact sagebrush stands for nesting habitat because they select dense sagebrush to conceal their nests. Population declines are attributed to habitat loss and conversion.

Northern harriers are a summer resident in Wyoming, but late-season records for Wyoming identify harriers in late November with some individuals wintering over (Johnsgard 1990). They utilize wetlands and mixed-grass prairie habitats for nesting and hunting. Nicholoff (2003) identified habitat conversion and pesticide use as the primary threats to this species.

Grasshopper sparrow: Preferred habitat for this species is mixed-grass prairie with conspicuous singing perches (Nicholoff 2003). They also require bare ground that provides insects and seeds for foraging. The project area could potentially support nesting grasshopper sparrows. Nicholoff (2003) identifies habitat conversion and incompatible livestock grazing practices as the primary threats to this species.

The sage sparrow is a sagebrush obligate associated with shrublands dominated by big sagebrush with a perennial bunchgrass understory (Holmes and Johnson 2005b). In Region 2, sage sparrows occur across Wyoming in prairie and foothills habitat where sagebrush dominates. In Colorado, breeding sage sparrows select only sizeable, low-elevation stands of big sagebrush or mixed sagebrush for nesting (Holmes and Johnson 2005).

Black-tailed prairie dog populations on the TBNG were reduced by a sylvatic plague epizootic in 2001. Many prairie dog colonies are recovering but are still below pre-plague numbers. Black-tailed prairie dogs create a shortgrass environment for a number of species including black-footed ferret, mountain plover, and burrowing owl. This species is prey for a number of raptors and mammals. The population on the TBNG appears stable over time with annual fluctuations. The fluctuations coincide with outbreaks in plague on the grassland and surrounding area.

Swift fox are found in shortgrass, mixed-grass, agricultural, and sagebrush habitats (Stephens and Anderson 2005). They are a small nocturnal carnivore that utilizes underground dens throughout the year. They maintain multiple dens in a breeding area and will move kits between dens if they feel there is a threat. They prey on small vertebrates and insects. The primary threats to this species are direct mortality from coyotes and habitat loss or fragmentation.

Rocky Mountain bighorn sheep: The Medicine Bow-Routt National Forest contains three bighorn sheep herds in the Wyoming unit (Laramie Peak, Douglas Creek, and Encampment River herds) and one herd in the Colorado unit (Mt. Zirkel herd). Populations of Rocky Mountain bighorn sheep experienced significant declines across their range from the 1800s to the mid-1900s due to competition from livestock, unregulated hunting, habitat loss, and disease introduced from domestic sheep. Translocation and reintroduction programs in the 1960s increased the bighorn populations; however, human disturbance, habitat loss, and respiratory disease from domestic sheep are still a large threat (Beechman et al. 2007).

Management indicator species (MIS)

Snowshoe hares are common and well distributed across the Medicine Bow. Pellet monitoring suggests the population is stable to possibly declining. The potential decline could be related to declines in lodgepole habitat resulting from the bark beetle outbreak.

The **Lincoln's sparrow** population appears stable in willow riparian areas on the Medicine Bow Forest. During monitoring, Lincoln's sparrows were commonly found across the forest. This sparrow nests and feeds in herbaceous vegetation below willow stands and sings from perches high in the willow overstory.

The **Wilson's warbler** population appears stable in willow riparian areas on the Medicine Bow Forest. During monitoring, they were commonly found across the forest. This warbler feeds and sings near the top of willow shrubs. It usually constructs nests in herbaceous vegetation below willow overstory but sometimes in the lowest branches of willows. It generally inhabits higher elevations than Lincoln's sparrow but there is much overlap.

Vesper sparrows are primarily summer residents on the Routt National Forest and use grass/forb habitats, middle to higher elevation sagebrush, mountain shrub, and piñon/juniper habitat found on the forest (Kingery 1998). The vesper sparrow population on the Routt National Forest appears stable. During monitoring, vesper sparrows were commonly found across the forest.

Plains sharp-tailed grouse on the Thunder Basin National Grassland are most often found in grasslands with a diversity of structural stages, including an abundance of high structure grasslands. Interspersed shrubs and shrub communities also contribute to habitat suitability for this species. During monitoring, sharp-tailed grouse were commonly found. The population appears stable over time with annual fluctuations.

The **black-tailed prairie dog** and **greater sage-grouse** are discussed in the *Sensitive Species* section above.

Other wildlife species of concern

The USFWS also identifies migratory birds as species requiring analysis during the project planning process. Particular focus is placed on bald and golden eagles, birds of conservation concern, and raptors.

A review of district wildlife observations shows that the majority of habitat for bald and golden eagles is on the TBNG. There are a handful of areas on the MBNF and RNF that provide potential bald eagle nesting habitat. The MBNF land and resource management plan (LRMP) and TBNG LRMP identify protection measures for bald and golden eagles. All bald or golden eagle nests will be identified during project planning and the appropriate buffers and timing limitations will be implemented to protect nesting birds.

All areas identified for treatment will be surveyed for the presence of raptor nests. All raptor nests identified during surveys will have protection measures (distance buffers, timing limitations, or both) applied as described in the RNF, MBNF, and TBNG land and resource management plans. For species without specific nest buffers determined within the plans, the respective district wildlife biologist will coordinate with USFWS to determine adequate protection measures.

Environmental Effects

Effects from Biological, Mechanical, and Cultural Treatments Common to all Alternatives

The following effects would apply under all alternatives analyzed for this project:

- Successful implementation of biocontrols would have beneficial impacts by restoring native vegetation and reducing or preventing spread of noxious weeds.
- Cultural treatments could have some short-term impacts through disturbance to individuals during project implementation, but they would not be significant. Cultural treatments would have secondary, beneficial impacts on habitat by restoring native vegetation and reducing or preventing spread of noxious weeds and invasive species.

- Grazing by domestic sheep and goats could affect wildlife with low mobility such as small mammals, ground-nesting birds, and Rocky Mountain bighorn sheep. Sheep and goats could disturb individuals and change vegetation cover and composition, and domestic goats or sheep used for targeted grazing can spread disease to wild bighorn sheep. Grazing could have small impacts to the following species: snowshoe hares, Lincoln's sparrow, Wilson's warbler, vesper sparrow, plain's sharp-tailed grouse, greater sage-grouse, and black-tailed prairie dog. The concentration of grazing animals used to remove weeds could cause these species to temporarily leave the sites. At most, 250 acres across the entire forest would be treated annually, disturbing no more than a portion of a few territories at one time. Snowshoe hares and birds could return to the sites immediately after treatment occurs; black-tailed prairie dogs could rise above ground immediately after treatment. If used appropriately, sheep and goat grazing could have long-term beneficial impacts on wildlife habitat by restoring native vegetation and reducing or preventing spread of invasive plant species.

  To be effective and not damage or conflict with other resources, sheep and goats used for weed control have to be confined to the infestation area, have access to water, be protected from predators, and be closely monitored so they can be removed if they start to damage desirable native plants. Sheep and goats can be a viable weed control option only in limited locations. Where the Forest Service has identified areas that emphasize bighorn sheep management, the potential for contact between bighorn sheep and domestic sheep and goats will be minimized (see protection measures in appendix A).

- Mechanical treatment methods could have site-specific impacts by disturbing individuals during breeding, foraging, nesting, or denning, but the impacts would be short-duration and would occur in small areas compared to the overall territory of most species. Mechanical treatment would have beneficial impacts on wildlife habitat by restoring native vegetation and reducing or preventing spread of invasive plant species.

- Prescribed fire would be implemented in conjunction with other treatment methods. Prescribed burning would impact some individuals that occur in areas of treatment through disturbance, direct mortality in some cases, and temporary loss of habitat until burned areas recover. The long-term effects would be beneficial by restoring native vegetation and reducing or preventing spread of invasive species. The protection measures in appendix A would limit short-term impacts.

As discussed previously in the *Vegetation* section, manual, mechanical, biological, and cultural treatments have limited effectiveness for controlling invasive species, and failure to control invasive species could adversely impact habitat for many species on the MBRTB. Invasive weeds species have the ability to compete with native vegetation and, in some cases, replace native vegetation in riparian habitats. This becomes important when managing for small populations (e.g., Preble's meadow jumping mouse) that have low habitat connectivity and mobility. In disturbed areas, invasive species may limit the regeneration of aspen and lodgepole pine which can impact habitat quality for snowshoe hares and red squirrels – both prey species for the Canada lynx. This is particularly important since much of the lynx habitat on the MBRNF has been altered by the mountain pine beetle epidemic and is currently in an unsuitable condition.

On the TBNG, cheatgrass invasion into big sagebrush stands degrades habitat for sagebrush-dependent species like the greater sage-grouse, shrikes, and sparrows. Once cheatgrass dominates the spaces between sagebrush plants, it increases the likelihood of wildfire. Repeated wildfire eventually eliminates big sagebrush, thereby eliminating sage habitat. Climate change models for the sagebrush region suggest increasing temperatures, atmospheric carbon dioxide levels, and episodes of severe weather that will both support the further spread of cheatgrass and increase fire disturbance to the detriment of sagebrush communities (Miller et al. 2011).

Effects from Herbicide Use in Alternatives 1, 2, and 3

Terrestrial animals may be exposed to herbicides from direct spray; ingestion of plants, prey, or water; ingestion through grooming; or inhalation of spray (SERA 2004a-f, 2005, 2006, 2007, 2009, 2011a-d). In addition, wildlife might spend long periods in contact with contaminated vegetation.

During laboratory studies, exposure to extremely high levels of most herbicides through direct ingestion of the herbicide or spraying often led to death or a variety of sub-lethal toxic effects including damage or irritation to the nervous system, kidneys, eyes, and skin and inhibition of reproduction. However, the doses required to produce such effects were many times higher than those wildlife would encounter from application of herbicides in the field even under worst-case scenarios.

Biomagnification is also a potential effect from herbicide use. Biomagnification is the increase in concentration of chemicals from one link in the food chain to the next. The result is that small concentrations of chemicals can lead to toxic effects for organisms high in the food chain. However for biomagnification to occur, the chemical must be long-lived, mobile, and fat-soluble. Chemicals that are water-soluble rather than fat-soluble will be excreted by an organism. The herbicides proposed for use in this project appear to be rapidly excreted (SERA 2004a-f, 2005, 2006, 2007, 2009, 2011a-d) and do not accumulate in tissues, although data was often limited. Because of this, these herbicides present little or no potential for bioaccumulation as detailed in the U.S. Department of Energy's herbicide fact sheets (U.S. DOE 2000a-k and 2006a-b).

The *Vegetation* section describes the general effects of herbicides on non-target vegetation. Herbicides can affect habitat by killing, injuring, or suppressing non-target vegetation that is necessary or desirable habitat for wildlife species. On the MBRTB, this is a concern for species associated with particular grass, forb, or shrub species for food or cover during their life cycle (greater sage-grouse) and with low mobility to move into different areas when their habitats are impacted (Preble's meadow jumping mouse). The degree to which herbicides affect non-target vegetation varies by specific herbicides, with some having more broad impacts than others (refer to the *Vegetation* section of EIS). Protection measure identified in appendix A would minimize the effects of herbicides on habitat.

Alternative 1 (No Change from Current Management)

Canada lynx: The actions that would be implemented under alternative 1 would result in a determination of *may affect, not likely to adversely affect*. No direct effects to lynx are anticipated from invasive species treatments under this alternative. The treatments may have some indirect effects to habitat for lynx and their prey. The treatments that occurred in 2013 are small in extent when compared to the size of the lynx analysis unit (LAU) and so impacts would be considered insignificant. Even in the case where multiple treatments may be used (e.g., grazing in combination with herbicide application), it is not anticipated that habitat would be reduced further for lynx or their prey. These treatments may reasonably be considered as insignificant when compared proportionally to the habitat available.

Some invasive plant species may not be controlled. This alternative would not reduce negative effects of cheatgrass (the species which infests the most acres on the MBRTB) or other invasive species not listed as noxious farm weeds by the states of Colorado or Wyoming. Therefore, some weed species will continue to increase, with negative consequences to native plant communities and dependent wildlife. The use of herbicides or other treatments has the potential to maintain or promote habitat quality for snowshoe hares and red squirrels by reducing the risk that non-native plant species invade the disturbed areas and limit the regeneration of aspen and lodgepole pine in the future. This is particularly important since much of the lynx habitat on the MBRNF has been altered by the mountain pine beetle epidemic and is currently in an unsuitable condition

The following is a summary of effects for each treatment action:

- For biocontrols, no direct effects to lynx would occur, since the biocontrol agent would pose no disturbance to breeding, foraging, or denning.
- Revegetation effects to lynx are unlikely since this species is a wide-ranging carnivore and would not be present in the area when revegetation was occurring. Cultural treatments would have indirect, positive effects on lynx habitat by restoring native vegetation and reducing or preventing spread of noxious weeds.
- Grazing can change trends in seral classes, which can have negative, indirect effects on lynx prey by reducing the availability of native habitats. Though grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- No direct or indirect effects to lynx are anticipated with the use of mechanical treatments, since these techniques would not be employed in lynx habitat.
- No prescribed burning would occur in lynx habitat that would result in stands returning to stand initiation structure stage. Thus, no direct effects to lynx from prescribed burning would occur. Prescribed burning may occur in non-lynx habitat, which may create positive, indirect effects for alternate prey species habitat within an LAU.
- No direct or indirect effects to lynx are anticipated from use of herbicides. The doses required to produce harmful effects were many times higher than a lynx would encounter from application of herbicides in the field even under worst-case scenarios.

Preble's meadow jumping mouse: The actions that would be implemented under alternative 1 would result in a determination of *may affect, likely to adversely affect* for this species. The lack of aerial application to control cheatgrass and the limits on invasive species that could be treated mean this alternative is less effective than alternatives 2 and 3 at reducing invasive species threats to Preble's habitat.

Invasive weeds species have the ability to compete with, and in some cases replace, native vegetation in riparian habitats. This can degrade or potentially eliminate habitat for Preble's. This becomes important when managing for small populations that have low habitat connectivity and mobility. Invasive species can be especially problematic after fire has burned over riparian habitat; species like thistle that thrive in disturbed areas can become dominant. Therefore, reducing the threats of invasive species in Preble's habitat is integral to this species' conservation.

Some impacts to Preble's meadow jumping mouse and their habitat would be anticipated from the invasive species treatments. Protection measures would be incorporated during project implementation to reduce these impacts. The following is a summary of effects for each treatment action under alternative 1:

- No direct effects to Preble's are anticipated with use of biocontrol agents, since no disturbance to breeding, foraging, or nesting would occur.
- In revegetation projects, surveys in Preble's habitat would occur prior to implementation. If the mouse is detected, timing limitations would be applied to avoid direct effects, but some disturbance during resting, foraging, or rearing young may occur.
- Sheep and goat grazing may have negative, direct effects by disturbing Preble's individuals with negative, indirect effects by changing vegetation cover and composition for Preble's habitat. Though sheep and goat grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.

- If mechanical treatments are proposed in Preble's meadow jumping mouse habitat, surveys for Preble's would be completed prior to implementation. Although most impacts to Preble's would be avoided with protection measures, some negative, direct effects (disturbance to individuals) may occur.
- In prescribed burns, some negative, indirect effects to Preble's habitat may occur. Over the mid- and long-term, positive, indirect effects are anticipated by improving habitat suitability for Preble's. Protection measures would be implemented when prescribed burning is planned in suitable Preble's habitat. Prescribed fires would be designed to burn no more than 25% of the Preble's habitat within each linear mile of habitat, and there would be a timing limitation during the Preble's hibernation period. Though protection measures are intended to reduce the impacts, some negative, direct effects to Preble's may occur due to disturbing individuals or arousing them during hibernation. Prescribed burning can be somewhat targeted, but some suitable habitat for Preble's may be burned while treating invasive species.
- No direct or indirect effects to Preble's are anticipated from use of herbicides. The doses required to produce harmful effects were many times higher than a Preble's would encounter from application of herbicides in the field even under worst-case scenarios.

Region 2 sensitive species

The actions that would be implemented under alternative 1 would result in a determination of *may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing* for the following sensitive species found in the project area:

Swift fox	Burrowing owl	Mountain plover
Rocky Mountain bighorn sheep	Grasshopper sparrow	McCown's longspur
Black-tailed prairie dog	Loggerhead shrike	Sage sparrow
Northern harrier	Greater sage-grouse	Short-eared owl
Ferruginous hawk	Chestnut-collared longspur	Brewer's sparrow
Bald eagle	Columbia sharp-tailed grouse	

The lack of effective treatment options under alternative 1 means some weed species will continue to increase, with negative consequences to native plant communities and dependent wildlife. Although control of invasive plant species would continue under this alternative, effective treatment of invasive plants would be hindered by the inability to use new approved herbicides and the restriction of only treating noxious weeds on the Wyoming and Colorado state noxious farm weed list. Thus some invasive plant species may not be controlled. Alternative 1 would not reduce negative effects of cheatgrass (which infests more than 97,000 acres on the MBRTB) or other invasive species not listed as noxious farm weeds.

Management indicator species (MIS)

Effects common to all MIS: Some invasive plant species and infestations would not be treated under alternative 1 due to funding limitations and limited effectiveness of available tools (e.g., hand pulling). Over the long-term, this could reduce habitat quantity and quality. This is particularly true for the following species which utilize sagebrush/grassland habitat: vesper sparrow, sharp-tailed grouse, and black-tailed prairie dog (covered above under R2 sensitive species).

Snowshoe hare: Treatments under alternative 1 would have no measureable impact to the primary snowshoe hare habitat – spruce-fir forest. There would be few disturbances to individual snowshoe hares or willow riparian habitats because treatment options are limited for this habitat, and weed infestations are usually small. The short-term disturbances of weed treatment on a few acres in portions of several territories would not affect snowshoe hare abundance annually or population trend over time.

Lincoln's sparrow, Wilson's warbler: Typically, there would be few disturbances to individual Lincoln's sparrows, Wilson's warblers, or willow riparian habitats because treatment is limited in riparian habitat, and weed infestations are usually small. Treatments could occur in willow-riparian habitat but methods, especially herbicide spraying, would be strictly limited by product labels, forest plan standards and guidelines for disturbances in riparian areas, and the resource protection measures in appendix A.

Vesper sparrow: Typically, there would be small disturbances to individual vesper sparrows or their habitat because treatment would occur on no more than 3,500 acres annually across the entire forest. Treatments would occur predominantly in shrubland and grassland habitat that supports vesper sparrows. Treatments methods, especially herbicide spraying, would be strictly managed by product labels and resource protection measures in appendix A. This alternative does not provide an effective means of treating cheatgrass. Cheatgrass would continue to dominate 97,000 acres and would expand annually. The resultant increase in fire frequency and intensity could reduce the availability of sagebrush for nest cover and song perches for this species.

Plains sharp-tailed grouse: Typically, there would be only small disturbances to individual sharp-tailed grouse or their habitat because treatment would occur on no more than 3,500 acres annually across the entire TBNG. Treatments methods, especially herbicide spraying, would be strictly managed by product labels and resource protection measures in appendix A. This alternative does not provide an effective means of treating cheatgrass. Cheatgrass would continue to dominate 97,000 acres and would expand annually. Therefore, a continued reduction in the quantity and quality of sharp-tailed grouse grassland habitat would be expected.

Alternative 2 (Preferred Alternative)

Threatened and candidate species

Canada lynx: Based on the potential effects identified, SRLA guidance, long- term benefits, and protection measures associated with this project, the actions that would be implemented under alternative 2 would result in a determination of *may affect, but not likely to adversely affect* for Canada lynx.

The following is a summary of effects for each treatment action:

- For biocontrols, no direct effects to lynx would occur, since the biocontrol agent would pose no disturbance to breeding, foraging, or denning.
- Revegetation effects to lynx are unlikely since this species is a wide-ranging carnivore and would not be present in the area when project was occurring. Cultural treatments would have indirect, positive effects on lynx habitat by restoring native vegetation and reducing or preventing spread of noxious weeds.
- Grazing can change trends in seral classes, which can have negative, indirect effects on lynx prey by reducing the availability of native habitats. Though grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- No direct or indirect effects to lynx are anticipated with the use of mechanical treatments since these techniques would not be employed in lynx habitat.
- No prescribed burning would occur in lynx habitat that would result in stands returning to stand initiation structure stage. Thus, no direct effects to lynx from prescribed burning would occur. Prescribed burning may occur in non-lynx habitat, which may create positive, indirect effects for alternate prey species habitat within an LAU.

- No direct or indirect effects to lynx are anticipated from use of herbicides. The doses required to produce harmful effects were many times higher than a lynx would encounter from application of herbicides in the field even under worst-case scenarios.
- No direct or indirect effects to lynx from aerial herbicide treatments are anticipated since treatments would occur well outside of lynx habitat.

No direct effects to lynx are anticipated. The treatments may have some indirect effects to habitat for lynx and their prey. The treatments that occurred in 2013 are small in extent when compared to the size of the LAU and so impacts would be considered insignificant. Even in the case where multiple treatments may be used (for example, grazing in combination with herbicide application), it is not anticipated that habitat would be reduced further for lynx or their prey. These treatments may reasonably be considered as insignificant when compared proportionally to the habitat available

Though herbicide use could kill broadleaf forbs that are important to snowshoe hares in summer, the proposed herbicides would not impact conifer species that are important forage and cover for snowshoe hares in winter. On the contrary, the use of herbicides or other treatments has the potential to maintain or promote habitat quality for snowshoe hares and red squirrels by reducing the risk that non-native plant species invade the disturbed areas and limit the regeneration of aspen and lodgepole pine in the future. This is particularly important since much of the lynx habitat on the MBRNF has been altered by the mountain pine beetle epidemic.

Preble’s meadow jumping mouse: Based on the potential effects identified and protection measures associated with this project, the actions that would be implemented under alternative 2 would result in a determination of *may affect, likely to adversely affect* Preble’s meadow jumping mouse.

Some impacts to Preble’s meadow jumping mouse and their habitat would be anticipated. Protection measures would be incorporated during project implementation to reduce these impacts. The preferred alternative is intended to eradicate, control the spread, or reduce the likelihood weeds invade new areas with various methods to maintain or improve wildlife habitat. This is particularly important for a threatened species that has specific habitat requirements but is isolated often by human development. Reducing the impacts of invasive species in the remaining habitat is of heightened importance. Invasive weeds species have the ability to compete with, and in some cases replace, native vegetation in riparian habitats. This can degrade or potentially eliminate habitat for Preble’s. This becomes important when managing for small populations that have low habitat connectivity and mobility. Invasive species can be especially problematic after fire has burned over riparian habitat; species like thistle that thrive in disturbed areas can become dominant. Therefore, reducing the threats of invasive species in Preble’s habitat is integral to this species’ conservation.

The following is a summary of effects for each treatment action:

- No direct effects to Preble’s are anticipated with use of biocontrol agents, since no disturbance to breeding, foraging, or nesting would occur.
- In revegetation projects, surveys in Preble’s habitat would occur prior to implementation. If the mouse is detected, no revegetation projects would be implemented from May 16 through September 30. This timing limitation would be applied to avoid direct effects, but some disturbance during resting, foraging, or rearing young may occur.
- If mechanical treatments are proposed in Preble’s meadow jumping mouse habitat, surveys for Preble’s would be completed prior to implementation. If the mouse is detected, no revegetation projects would be implemented from May 16 through September 30. This timing limitation would be applied to avoid direct effects, but some disturbance during resting, foraging, or rearing young may occur. Although most impacts to Preble’s would be avoided with protection measures, some negative, direct effects (disturbance to individuals) may occur.

- Sheep and goat grazing may have negative, direct effects by disturbing Preble's individuals with negative, indirect effects by changing vegetation cover and composition for Preble's habitat. Though sheep and goat grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- In prescribed burns, some negative, indirect effects to Preble's habitat may occur. Over the mid- and long-term, positive, indirect effects are anticipated by improving habitat suitability for Preble's. Protection measures will be implemented when prescribed burning is planned in habitats suitable for Preble's. Prescribed fires would be designed to burn no more than 25% of the Preble's habitat within each linear mile of habitat and there would be a timing limitation during the Preble's hibernation period. Though protection measures are intended to reduce the impacts, some negative, direct effects to Preble's may occur: disturbing individuals or arousing them during hibernation. Prescribed burning can be somewhat targeted, but some suitable habitat for Preble's may be burned while treating invasive species.
- No direct or indirect effects to Preble's are anticipated from use of herbicides. The doses required to produce harmful effects were many times higher than a Preble's would encounter from application of herbicides in the field even under worst-case scenarios.
- There would be potential for herbicide drift on Preble's since this species has low mobility. In addition, low flying aircraft can create noise and may appear as large flying predators thereby flushing small mammals such as Preble's. Though Preble's habitat is not likely the focus of aerial herbicide treatment, some inadvertent negative, direct effects to Preble's and their habitat may occur.

Region 2 sensitive species

For sensitive species, the actions that would be implemented under alternative 2 would result in a determination of *may adversely impact individuals, but is not likely to result in a loss of viability in the planning area, nor cause a trend toward federal listing.* Rationale for the determination is summarized in the following table. There would be short-term impacts from disturbance associated with herbicide application (ground/aerial). There would be long-term beneficial impacts by improving forage and habitat and reducing potential disturbance from fire.

Table 16. Rationale for sensitive species' determinations under the preferred alternative (alternative 2).

Rationale for determination	Species
Short-term impacts from disturbance associated with herbicide application (ground/aerial). Long-term beneficial impact by improving prey species habitat.	Swift fox, northern harrier, ferruginous hawk, bald eagle, loggerhead shrike, burrowing owl, short-eared owl
Short-term impacts from disturbance associated with herbicide application (ground/aerial). Long-term benefit by improving forage or forage availability.	Black-tailed prairie dog
Short-term impacts from disturbance associated with herbicide application (ground/aerial). Potential disease transmission from domestic sheep and goats used for targeted grazing. Long-term benefit by improving forage availability.	Rocky Mountain bighorn sheep

Rationale for determination	Species
Short-term impacts from disturbance associated with herbicide application (ground/aerial). Long-term beneficial impact by improving foraging and nesting habitat, and reducing potential disturbance from fire.	Greater sage-grouse (see additional discussion below), Brewer's sparrow, grasshopper sparrow, sage sparrow
Short-term impacts from disturbance associated with herbicide application (ground/aerial). Long-term beneficial impact to nesting and foraging habitat.	Mountain plover, chestnut-collared longspur, McCown's longspur

Greater sage-grouse: Aerial herbicide application has only a slight probability of causing adverse effects to individual sage-grouse due to the resource protection measures (appendix A) and product label restrictions. Aerial application would not cause adverse effects sufficient to alter the sage-grouse population trend on the TBNG.

Aerial application could cause short-term displacement of individual sage-grouse. Sage-grouse would be likely to leave treatment areas due to aircraft noise and use other portions of their home ranges. Sage-grouse could return to treated sites within an hour of disturbance. Typically, there would be only small disturbances to individual sage-grouse or their habitat because treatment would occur on no more than 5,000 acres annually across the entire TBNG, and sage-grouse abundance would be lower where habitat quality is reduced already by cheatgrass stands.

Aerial application would improve thousands of acres of habitat for sage-grouse and other sage-dependent species over the long-term. Cheatgrass and other weeds would be replaced by native grasses, forbs and, eventually, shrubs. This vegetation shift would increase habitat quality and quantity and reduce the higher fire frequencies associated with cheatgrass monocultures. For sage-grouse, these improvements would contribute toward supporting a more stable population over time.

Fire is one of the primary factors linked to loss of sagebrush-steppe habitat and corresponding population declines of greater sage-grouse (Connelly and Braun 1997; Miller and Eddleman 2001). Loss of sagebrush habitat to wildfire has been increasing in the western portion of the greater sage-grouse range. The increase in mean fire frequency has been facilitated by the incursion of nonnative annual grasses, primarily cheatgrass (*Bromus tectorum*) and medusahead (*Taeniatherum asperum*), into sagebrush ecosystems (Billings 1994; Miller and Eddleman 2001).

Management indicator species (MIS)

Effects common to all MIS: Alternative 2 provides the opportunity to treat more invasive species and with more herbicide tools (including aerial spraying) than alternative 1. These options would provide a greater ability to prevent invasive weed spread and reduce invasive weeds already occurring in MIS habitat.

The short-term disturbances of weed treatment on a few acres in portions of several territories would not affect MIS abundance annually or population trend over time for the following MIS: snowshoe hare, Lincoln's sparrow, Wilson's warbler, and vesper sparrow.

This alternative has a greater ability to maintain and improve habitat in the long-term, which would help support more stable populations over time for the following MIS: snowshoe hare, Lincoln's sparrow, Wilson's warbler, vesper sparrow, and sharp-tailed grouse.

Snowshoe hare, Lincoln's sparrow, Wilson's warbler: Aerial application should have little, if any, effect on habitat for these species because few acres would be treated in the willow riparian habitat they use. Aerial application would be used most often in large infestations, primarily cheatgrass, which has not occurred in most willow riparian habitats.

Vesper sparrow: Aerial application would not cause adverse effects sufficient to alter the vesper sparrow population trend on the forest. There could be aerial application of herbicide in the upland habitat inhabited by vesper sparrows on the Routt National Forest. This treatment method could cause short-term disturbance to individual vesper sparrows. Sparrows would be likely to temporarily leave treatment areas due to aircraft noise and use other portions of their territories. Aerial application has only a slight chance of causing adverse effects to individual vesper sparrows due to the resource protection measures in appendix A and product label restrictions. Aerial application would improve vesper sparrow habitat over the long-term.

Plains sharp-tailed grouse: Aerial application would not cause adverse effects sufficient to alter the sharp-tailed grouse population trend on the TBNG. Aerial application has only a slight chance of causing adverse effects to individual sharp-tailed grouse due to the resource protection measures (appendix A) and product label restrictions. Aerial application could cause short-term disturbance to individual sharp-tailed grouse. Sharp-tailed grouse would be likely to temporarily leave treatment areas due to aircraft noise and use other portions of their home ranges.

Aerial application would improve thousands of acres of sharp-tailed grouse habitat over the long-term. Cheatgrass and other weeds would be replaced by native grasses, forbs and, eventually, shrubs. These changes would increase habitat quality and quantity as nesting habitat and brood rearing habitat.

Other wildlife species of concern

In general, aerial application of herbicide is a concern because there is more potential for drift of herbicide into non-target areas than there is when ground-based equipment is used. There is also potential for drift onto wildlife species during implementation, particularly species that have low mobility such as small mammals, nesting birds, or insects. This concern would be minimized by following herbicide label instructions and implementing resource protection measures in appendix A.

There is also potential for disturbance from low-flying aircraft. Low-flying aircraft can create noise that most wildlife species are not habituated to. They also can seem like large flying predators, which can flush small mammals and ground nesting species of birds. On the MBRTB, aerial application would be limited to relative large, heavily infested areas or remote, inaccessible areas. In most cases, the target is cheatgrass which has invaded large areas on the TBNG or isolated areas in big game winter range on the Medicine Bow-Routt national forests. Impacts to migratory birds and raptors and their habitat should be minimized by implementing the resource protection measures listed in appendix A.

Alternative 3 (No Aerial Application of Herbicides)

Threatened and candidate species

Canada lynx: Based on the potential effects identified, SRLA guidance, long-term benefits, and protection measures associated with this project, the actions that would be implemented under alternative 3 would result in a determination of *may affect, not likely to adversely affect.* No direct effects to lynx are anticipated from invasive species treatments under this alternative. The treatments may have some indirect effects to habitat for lynx and their prey. The treatments that occurred in 2013 are small in extent when compared to the size of the LAU and so impacts would be considered insignificant. Even where multiple treatments may be used (for example, grazing in combination with herbicide application), it is not anticipated that habitat would be reduced further for lynx or their prey. These treatments may reasonably be considered as insignificant when compared proportionally to the habitat available.

The use of herbicides or other treatments has the potential to maintain or promote habitat quality for snowshoe hares and red squirrels by reducing the risk that non-native plant species invade the disturbed areas and limit the regeneration of aspen and lodgepole pine in the future. This is particularly important since much of the lynx habitat on the MBRNF has been altered by the mountain pine beetle epidemic and is currently in an unsuitable condition.

The following is a summary of effects for each treatment action:

- For biocontrols, no direct effects to lynx would occur, since the biocontrol agent would pose no disturbance to breeding, foraging, or denning.
- Revegetation effects to lynx are unlikely since this species is a wide-ranging carnivore and would not be present in the area when project was occurring. Cultural treatments would have indirect, positive effects on lynx habitat by restoring native vegetation and reducing or preventing spread of noxious weeds.
- Grazing can change trends in seral classes, which can have negative, indirect effects on lynx prey by reducing the availability of native habitats. Though grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- No direct or indirect effects to lynx are anticipated with the use of mechanical treatments, since these techniques would not be employed in lynx habitat.
- No prescribed burning would occur in lynx habitat that would result in stands returning to stand initiation structure stage. Thus, no direct effects to lynx from prescribed burning would occur. Prescribed burning may occur in non-lynx habitat, which may create positive, indirect effects for alternate prey species habitat within an LAU.
- No direct or indirect effects to lynx are anticipated from use of herbicides. The doses required to produce harmful effects were many times higher than a lynx would encounter from application of herbicides in the field even under worst-case scenarios.

Preble's meadow jumping mouse: The actions that would be implemented under alternative 3 would result in a determination of *may affect, likely to adversely affect.* The effects of alternative 3 would be similar to alternative 1. As noted in the alternative 2 discussion, reducing the impacts of invasive species in the Preble's habitat is important. However without aerial application, the extent of treatment is reduced and invasive species like cheatgrass would continue to spread. Invasive weeds species have the ability to compete with, and in some cases replace, native vegetation in riparian habitats. This can degrade or potentially eliminate habitat for Preble's. Reducing the threats of invasive species in Preble's habitat is integral to this species' conservation and alternative 3 is less effective than alternative 2 at doing this.

Some impacts to Preble's meadow jumping mouse and their habitat would be anticipated from the invasive species treatments. Protection measures would be incorporated during project implementation to reduce these impacts. The following is a summary of effects for each treatment action under alternative 3:

- No direct effects to Preble's are anticipated with use of biocontrol agents, since no disturbance to breeding, foraging, or nesting would occur.
- In revegetation projects, surveys in Preble's habitat would occur prior to implementation. If the mouse is detected, timing limitations would be applied to avoid direct effects, but some disturbance during resting, foraging, or rearing young may occur.

- Sheep and goat grazing may have negative, direct effects by disturbing Preble's individuals with negative, indirect effects by changing vegetation cover and composition for Preble's habitat. Though sheep and goat grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- If mechanical treatments are proposed in Preble's meadow jumping mouse habitat, surveys for Preble's would be completed prior to implementation. Although most impacts to Preble's would be avoided with protection measures, some negative, direct effects (disturbance to individuals) may occur.
- In prescribed burns, some negative, indirect effects to Preble's habitat may occur. Over the mid- and long-term, positive, indirect effects are anticipated by improving habitat suitability for Preble's. Protection measures will be implemented when prescribed burning is planned in habitats suitable for Preble's. Prescribed fires would be designed to burn no more than 25% of the Preble's habitat within each linear mile of habitat and there would be a timing limitation during the Preble's hibernation period. Though protection measures are intended to reduce the impacts, some negative, direct effects to Preble's may occur: disturbing individuals or arousing them during hibernation. Prescribed burning can be somewhat targeted, but some suitable habitat for Preble's may be burned while treating invasive species.
- No direct or indirect effects to Preble's are anticipated from use of herbicides. The doses required to produce harmful effects were many times higher than a Preble's would encounter from application of herbicides in the field even under worst-case scenarios.

Region 2 sensitive species

The effects of alternative 3 would be similar to alternative 1. Without aerial application, the extent of treatment is reduced, and invasive species like cheatgrass would continue to spread. The actions that would be implemented under alternative 3 would result in a determination of *may adversely impact individuals, but is not likely to result in a loss of viability in the Planning Area, nor cause a trend toward federal listing.* The rationale is shown in the following table.

Table 17. Rationale for sensitive species' determinations under alternative 3.

Rationale	Species
Short-term impacts from disturbance associated with ground-based herbicide application. Long-term beneficial impact by improving prey species habitat.	Swift fox, northern harrier, ferruginous hawk, bald eagle, loggerhead shrike, burrowing owl, Short-eared owl
Short-term impacts from disturbance associated with ground-based herbicide application. Potential disease transmission from domestic sheep and goats used for targeted grazing. Long-term benefit by improving forage availability.	Rocky Mountain bighorn sheep
Short-term impacts from disturbance associated with ground-based herbicide application. Long-term beneficial impact by improving forage.	Black-tailed prairie dog
Short-term impacts from disturbance associated with ground-based herbicide application. Long-term beneficial impact by improving foraging and nesting habitat and reducing potential disturbance from fire.	Greater sage-grouse, grasshopper sparrow, sage sparrow, Brewer's sparrow
Short-term impacts from disturbance associated with ground-based herbicide application. Long-term beneficial impact to nesting and foraging habitat.	Chestnut-collared longspur, McCown's longspur, mountain plover

Management indicator species (MIS)

Snowshoe hare, Lincoln's sparrow, Wilson's warbler: Since little, if any, willow riparian habitat would be treated by aerial application, impacts to these species, their habitats, and population trends would be the same as alternative 2.

Vesper sparrow, plains sharp-tailed grouse: Fewer acres of cheatgrass would be treated under alternative 3 compared to alternative 2. However, some habitat would be improved over time, and more weed species could be controlled than under alternative 1. Habitat improvement would help support more stable populations over time. The short-term disturbances of various other weed treatments on a few acres in portions of several territories will not affect vesper sparrow or sharp-tailed grouse abundance annually or population trends over time.

Alternative 4 (No Herbicide Use)

Threatened and candidate species

Canada lynx: Based on the potential effects identified, SRLA guidance, long-term benefits, and protection measures associated with this project, the actions that would be implemented under alternative 4 would result in a determination of *may affect, not likely to adversely affect.*

Invasive weed species would not be effectively treated under this alternative. Biological and mechanical control methods do not have the ability to treat large infestations of invasive species of weeds like cheatgrass. Although there is no documentation of the magnitude of effects of non-native invasive plant infestations on lynx habitat in the United States, the potential exists for large-scale impacts and alteration of habitat. Weeds such as diffuse and spotted knapweed (*Centaurea diffusa, C. maculosa*), leafy spurge (*Euphorbia* spp.), rush skeletonweed (*Chondrilla juncea*), dalmation toadflax (*Linaria dalmatica*), and Canada thistle (*Cirsium arvense*) have the potential to alter habitat at both the local and ecosystem scale. Many of these plants are more easily eradicated at infestation levels of a few plants or a few acres. Once established, they spread aggressively and become extremely difficult to control (Ruediger et al. 2000).

The following is a summary of effects for each treatment action available under this alternative:

- For biocontrols, no direct effects to lynx would occur, since the biocontrol agent would pose no disturbance to breeding, foraging, or denning.
- Revegetation effects to lynx are unlikely since this species is a wide-ranging carnivore and would not be present in the area when project was occurring. Cultural treatments would have indirect, positive effects on lynx habitat by restoring native vegetation and reducing or preventing spread of noxious weeds.
- Grazing can change trends in seral classes, which can have negative, indirect effects on lynx prey by reducing the availability of native habitats. Though grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- No direct or indirect effects to lynx are anticipated with the use of mechanical treatments, since these techniques would not be employed in lynx habitat.
- No prescribed burning would occur in lynx habitat that would result in stands returning to stand initiation structure stage. Thus, no direct effects to lynx from prescribed burning would occur. Prescribed burning may occur in non-lynx habitat which may create positive, indirect effects for alternate prey species habitat within an LAU.

Preble's meadow jumping mouse: The actions that would be implemented under alternative 4 would result in a determination of *may affect, likely to adversely affect.* The lack of herbicides to treat invasive species, limited number of treated acres, and limits on species that could be treated mean this alternative is the least effective at reducing invasive species threats to Preble's habitat. Biological and mechanical treatments are not effective for large infestations of invasive species like cheatgrass.

Invasive weeds species have the ability to compete with, and in some cases replace, native vegetation in riparian habitats. This can degrade or potentially eliminate habitat for Preble's. This becomes important when managing for small populations that have low habitat connectivity and mobility. Invasive species can be especially problematic after fire has burned over riparian habitat; species like thistle that thrive in disturbed areas can become dominant. Therefore, reducing the threats of invasive species in Preble's habitat is integral to this species conservation.

Some impacts to Preble's meadow jumping mouse and their habitat would be anticipated from the invasive species treatments. Protection measures would be incorporated during project implementation to reduce these impacts. The following is a summary of effects for each treatment action under alternative 4:

- No direct effects to Preble's are anticipated with use of biocontrol agents, since no disturbance to breeding, foraging, or nesting would occur.
- In revegetation projects, surveys in Preble's habitat would occur prior to implementation. If the mouse is detected, timing limitations would be applied to avoid direct effects, but some disturbance during resting, foraging, or rearing young may occur.
- Sheep and goat grazing may have negative, direct effects by disturbing Preble's individuals with negative, indirect effects by changing vegetation cover and composition for Preble's habitat. Though sheep and goat grazing can have negative effects, it should be noted that sheep and goats would be used to target invasive species.
- If mechanical treatments are proposed in Preble's meadow jumping mouse habitat, surveys for Preble's would be completed prior to implementation. Although most impacts to Preble's would be avoided with protection measures, some negative, direct effects to Preble's may occur related to disturbance to individuals.
- In prescribed burns, some negative, indirect effects to Preble's habitat may occur. Over the mid and long-term, positive, indirect effects are anticipated by improving habitat suitability for Preble's. Protection measures will be implemented when prescribed burning is planned in habitats suitable for Preble's. Prescribed fires would be designed to burn no more than 25% of the Preble's habitat within each linear mile of habitat and there would be a timing limitation during the Preble's hibernation period. Though protection measures are intended to reduce the impacts, some negative, direct effects to Preble's may occur: disturbing individuals or arousing them during hibernation. Prescribed burning can be somewhat targeted, but some suitable habitat for Preble's may be burned while treating invasive species.

Region 2 sensitive species

For sensitive species, the actions that would be implemented under alternative 4 would result in a determination of *may adversely impact individuals, not likely to result in a loss of viability in the planning area, or cause a trend toward federal listing.* Rationale for the determination is shown in the following table.

Table 18. Rationale for the determination for sensitive species under alternative 4.

Rationale for determination	Species
Will not maintain habitat for prey species.	Swift fox, northern harrier, ferruginous hawk, bald eagle, loggerhead shrike, burrowing owl, short-eared owl
Will reduce forage availability.	Black-tailed prairie dog
Will reduce forage availability Potential for disease transmission from domestic sheep and goats used for targeted grazing.	Rocky Mountain bighorn sheep
Will reduce forage availability, nesting, and breeding habitat. Will increase the potential of catastrophic fire events.	Greater sage-grouse, grasshopper sparrow, sage sparrow, Brewer's sparrow, mountain plover, chestnut-collared longspur, McCown's longspur

Habitat for sage-dependent species would continue to be altered negatively and become unsuitable over time. By not utilizing herbicides to treat invasive plants, there is potential for increased infestation in key habitats for sensitive species. This could reduce the current availability of foraging, nesting, wintering, and breeding habitat for all sensitive species considered. Large infestations of cheatgrass cannot be effectively treated using manual, mechanical, biological, or cultural control methods. In sagebrush communities infested by cheatgrass, fire frequency and intensity would increase which could permanently alter habitat for sage-dependent species.

Management indicator species (MIS)

Snowshoe hare, Lincoln's sparrow, Wilson's warbler: The quality and quantity of willow riparian habitat for these species would decline over time across the Medicine Bow National Forest. This alternative would likely lead to a reduction in willow riparian habitat in the long-term, which would reduce conditions needed to support more stable populations of these three species over time. The manual, mechanical, biological, and cultural control methods available in this alternative would not be sufficient to reduce many existing weed infestations, prohibit expansion of many existing weed infestations, or prohibit infestations of new weed species in willow riparian habitat. The short-term disturbances from weed treatment on a few acres would not affect annual abundance or population trend for these species.

Vesper sparrow, plains sharp-tailed grouse: The quality and quantity of shrubland and grassland habitat would decline over time across the Routt National Forest and TBNG. This alternative would likely lead to a reduction in habitat in the long-term, which would reduce conditions needed to support more stable vesper sparrow and sharp-tailed grouse populations over time. The available manual, mechanical, biological, and cultural control methods would not be effective on many invasive weed species or would be too costly to treat many acres. Those methods would be particularly ineffective on cheatgrass since it is so common and spreads easily. The short-term disturbances from weed treatment on a few acres would not affect annual abundance or population trend for these species.

Cumulative Effects to Threatened Species from the Preferred Alternative (Alternative 2)

Under the Endangered Species Act of 1973, as amended, cumulative effects are defined as, "the effect of future state or private activities not involving federal activities that is reasonably certain to occur within the action area of an action subject to consultation". Within the project area, 64% of the surface area is managed by the Forest Service, 32% is privately owned, and 4% is state-owned.

The past, present, and reasonably foreseeable future actions considered in the cumulative effects analysis are oil and gas exploration and development, coal mining, livestock grazing and wildlife use, and timber management. Oil, gas, and mineral extraction and timber management (in response to the bark beetle epidemic) are expected to increase on MBRTB in the future. Oil, gas, and mineral extraction are expected to increase on the private and state lands intermingled with the TBNG in the foreseeable future. Timber management is expected to increase on state and private lands intermingled with the MBRNF. Increases in oil exploration and development, coal mining, and timber management may increase habitat fragmentation and disturbance.

Timber management in response to the bark beetle epidemic has the greatest potential to affect individual lynx and habitat. Existing forest stands provide multi-story habitat for lynx and their prey. Timber management is expected to maintain pockets of this habitat type; however, those remaining patches would be too small to maintain prey populations throughout the treatment areas. This could result in direct loss of potential foraging and denning habitat in the treated acres. The surrounding area on private land has the highest potential to contribute to reduction in lynx habitat, as they may not follow the SRLA guidance or consult with USFWS. Reduction of lynx habitat may contribute to reduced fitness and reproductive success in individual lynx. There also could be an overall reduction in lynx habitat as dead trees caused by the beetle epidemic continue to decay and fall.

No impacts to Preble’s from vegetation (timber) management are anticipated on state or private lands.

Fire: For the first few years after a burn, there appears to be a negative correlation between lynx use and the amount of area burned. This short-term effect is likely due to the removal of cover which reduces snowshoe hare populations and possibly increased competition from coyotes in open habitats (Ruediger et al. 2000).

Fire can degrade Preble’s habitat from increased run off, which in turn can cut banks and cause ash deposits on top of habitat. It also has the potential to decrease water quality from ash and sediment loading.

When wildland fires may impact habitat for threatened or endangered species, the Forest Service or other agencies initiate emergency consultation with the USFWS and work closely with the USFWS to attempt to avoid impacts. In some cases, fires are not easily controlled and may affect habitat on state or private lands. If this occurs, USFWS provides guidance on how to restore threatened or endangered species habitat. Any recommendations will be provided to state or private landowners.

Grazing and browsing: There is livestock grazing on the intermingled state and private lands within the MBRNF administrative boundary. In some areas, the livestock grazing is coordinated with the Forest Service depending on how the allotment management plans are designed. In riparian areas within lynx habitat, grazing may result in reduced winter browse for snowshoe hares. Grazing may also impact plant communities that connect patches of lynx habitat and could modify the structure and composition. Though livestock grazing should be managed for mid to late seral conditions to provide for maximum cover (Ruediger et al 2000), these protection measures cannot be assumed on state and private lands when livestock grazing is not part of an allotment management plan.

Preble’s habitat can be impacted by grazing and browsing due to a reduction in cover. Cattle tend to congregate in riparian areas when there is less water available from other sources. This can lead to trampling of habitat, bank destabilization, and a reduction in water quality. These impacts are often mitigated on USFS lands, but this not always the case on state and private lands and could contribute to the overall reduction in Preble’s habitat.

Cumulative Effects to Region 2 Sensitive Species

The past, present, and reasonably foreseeable future actions considered in the cumulative effects analysis are oil and gas exploration and development, coal mining, livestock grazing and wildlife use, recreation, prescribed fire, and timber management. Oil, gas, and mineral extraction; timber management (in response to the bark beetle epidemic); and recreation are expected to increase on MBRTB in the future. Increases in oil exploration and development, coal mining, and timber management may increase habitat fragmentation and disturbance.

Minerals development: Impacts to greater sage-grouse, Brewer's sparrows, sage sparrows, and grasshopper sparrows from minerals development on TBNG are significant and are expected to remain that way, independent of this proposal. Sagebrush obligate populations require large landscapes, thus even slight fragmentation from somewhat dispersed disturbances may lead to population declines and regional extinctions. With increased oil and gas development on and off federal lands, it is anticipated that these populations may decrease. Minerals development creates fragmentation of habitat, increased predator perches (from infrastructure like power lines), increased noise from human activity and traffic, increased chance of collision from vehicles and from birds flying into infrastructure, and overall reduction in habitat quality. Currently, the USFS is following management identified in the core area direction from the Wyoming Governor's Office to help protect sage-grouse when implementing minerals projects.

Energy development and its infrastructure can also cause habitat loss and fragmentation for the black-tailed prairie dog. The grassland plan for the TBNG contains standards and guidelines to reduce these impacts.

Timber management: The biggest impacts to timber-dependent species are from the loss of trees to beetle kill and the resulting management of the dead trees. It is expected that with further stand decomposition, there will be increased management of timber both on federal and private lands.

Fire: Invasion of sagebrush habitat by annual grasses may result in the conversion of disturbed sagebrush areas into unsuitable habitat for sagebrush obligates (Johnson et al. 2011). Connelly and others (2000) found that greater sage-grouse leks become inactive in sagebrush communities dominated by exotic vegetation.

In general, fire doesn't burn intensely in riparian areas; however, it can degrade riparian habitat from increased runoff, which in turn can cut banks and cause ash deposits on top of habitat. Most impacts from fire are anticipated to be temporary, and riparian areas will recover.

Continued fire exclusion may reduce the quality and quantity of habitat for timber species. As a result of fire suppression, forest composition and structure have become more homogeneous, are composed of more shade-tolerant species with more canopy layers, and are more susceptible to severe fires, insects, and diseases (Ruediger et al. 2000).

Recreation: In general, most wildlife species can tolerate some level of disturbance due to recreation activities. There is a more direct impact to species like sage-grouse which are legal to hunt. Some wildlife species can adapt to human activities, if the activity generally occurs at predictable times at the same places. Some animals may become habituated to the activity. Response of the animal to the human-animal encounter is dependent upon the behavioral state of the animal, the type of human activity, and the time and location of the recreation activity (Ruediger et al. 2000).

Livestock grazing: In riparian areas, livestock grazing may result in reduced winter browse for small mammals and big game species and can lead to trampling of habitat and bank destabilization. Grazing may also impact plant communities that connect patches of forested habitat.

Grazing can reduce cover for grassland species like sage-grouse, which in turn makes them more susceptible to predation from both avian and terrestrial predators. Also, as a result of grazing, there can be less cover for nesting and fewer forbs available for foraging. However, annual rangeland monitoring and adherence to grassland plan livestock grazing standards and guidelines ensure that upland habitat is maintained for sage-grouse in the long-term.

Disease: For black-tailed prairie dogs, plague is probably the most influential factor on the TBNG because it is unpredictable, unmanageable, and will continue in the foreseeable future. A reduction of prairie dog acreages as a result of plague could impact some sensitive species including the black-tailed prairie dog, burrowing owls, mountain plover, McCown's longspur, chestnut-collared longspur, ferruginous hawk, and swift fox.

The mosquito-borne West Nile virus is a fatal neuroinvasive disease in wild birds that has expanded quickly across the U.S. since 1999 (Walker and Naugle 2011). It was first identified in greater sage-grouse range in 2002 (Kilpatrick et al. 2007). Greater sage-grouse show little resistance to this virus and, due to its transmission, options for controlling the spread of West Nile virus are limited (Johnson et al. 2011).

Poisoning and recreational shooting can have direct impacts to prairie dog populations. Over the last three years, 1,700 acres of prairie dog towns have been poisoned on the TBNG to prevent dog colony spread onto private land. At the same time, the recreational shooting closure on the TBNG has been expanded to include 100,460 acres.

Cumulative Effects to Management Indicator Species (MIS)

Greater sage-grouse and black-tailed prairie dogs are discussed above in the sensitive species section.

Snowshoe hare, Lincoln’s sparrow, Wilson’s warbler

Under alternatives 1 and 4, it is likely that some willow riparian habitat on private, state, and BLM land would decline in quality and quantity for these three species. Invasive weeds exist in their willow riparian habitat on state, private, and BLM lands adjacent to the Medicine Bow and Routt national forests. Treatment tools on these lands are not as limited as they are on the forest. There is more opportunity to maintain and improve weed-invaded habitat in the long-term on these lands. However, there is also a higher probability for these adjacent lands to be reinvaded annually by weeds from the forest.

Under alternative 1, fewer invasive species would be effectively controlled and fewer tools would be available to control them. Over time, potential large changes in habitat due to invasive species (as observed with cheatgrass expansion in shrublands) could cause population declines for the snowshoe hare, Lincoln’s sparrow, and Wilson’s warbler on the forest. Livestock and wildlife use of riparian areas could reduce the quality or quantity of habitat in the long-term. However, annual rangeland monitoring and adherence to forest plan livestock grazing guidelines help ensure that willow riparian habitat is maintained in the long-term.

Under alternatives 2 and 3, there would more opportunity to maintain and improve willow riparian habitat in the long-term. Treatment tools on forest and non-forest lands would be similar; so there could be more cooperative and effective planning to control invasive species and reinfestation of adjacent non-forest lands from the forest would be minimized.

Livestock and wildlife use of riparian areas would have a lower probability of spreading weeds and leading to a reduction in quality or quantity of habitat in the long-term. Annual rangeland monitoring and adherence to forest plan livestock grazing guidelines help ensure that willow riparian habitat is maintained in the long-term.

Vesper sparrow, plains sharp-tailed grouse

Under alternatives 1 and 4, it is likely that some shrubland and grassland habitat on private, state, and BLM land would decline in quality and quantity for vesper sparrows and plains sharp-tailed grouse. Invasive weeds exist in vesper sparrow and plains sharp-tailed grouse shrubland and grassland habitats on state, private, and BLM lands adjacent to the forest. Treatment tools on these lands are not as limited as they are on the forest. There is more opportunity to maintain and improve weed-invaded habitat for these two species in the long-term. However, there is also a higher probability for these non-forest lands to be reinvaded annually by weeds from the forest.

The lack of effective cheatgrass treatment under these two alternatives would perpetuate the changed fire cycle and subsequent reduction in quality or quantity of shrubland and grassland habitats. Cheatgrass infestations develop into monocultures that can expand rapidly. These monocultures can change the local fire regime to more frequent fires which consume more adjacent native shrubland and grassland with each fire event. Over time, large changes in habitat due to invasive species (for example, cheatgrass expansion in shrublands) could cause the population declines for Vesper sparrow and plains sharp-tailed grouse on the forest.

Livestock and wildlife use of upland habitat could lead to a reduction in quality or quantity of vesper sparrow and plains sharp-tailed grouse habitat in the long-term. Annual rangeland monitoring and adherence to forest plan livestock grazing guidelines ensure that upland habitat is maintained in the long-term.

Habitat loss and fragmentation from energy development are also factors affecting sharp-tailed grouse populations. Vodehnal and Haufler (2007) noted that energy development and its infrastructure are primary issues affecting sharp-tailed grouse populations.

Under alternative 2, there would be more opportunity to maintain and improve weed-invaded vesper sparrow and plains sharp-tailed grouse habitat in the long-term. Treatment tools on forest and non-forest lands would be similar, so there could be more cooperative and effective planning to control invasive species, and reinfestation of adjacent non-forest lands from the forest would be minimized.

Cheatgrass reduction and control can re-establish normal fire return cycles. This return would aid the restoration to native grassland and shrubland habitat.

Livestock and wildlife use of upland habitat would have a lower probability of spreading weeds and leading to a reduction in quality or quantity of vesper sparrow and plains sharp-tailed grouse habitat in the long-term. Livestock and wildlife are known to transport invasive species to new locations. Under alternative 2, more invasive species could be effectively controlled and there would be more tools available to control them. Annual rangeland monitoring and adherence to forest plan livestock grazing guidelines ensure that upland habitat is maintained in the long-term.

Habitat loss and fragmentation from energy development are also factors affecting sharp-tailed grouse populations. Vodehnal and Haufler (2007) noted that energy development and its infrastructure are primary issues affecting sharp-tailed grouse populations.

Under alternative 3, it is likely that some shrubland and grassland habitat on private, state, and BLM land would decline in quality and quantity for vesper sparrows and plains sharp-tailed grouse. Invasive weeds exist in vesper sparrow and plains sharp-tailed grouse shrubland and grassland habitats on state, private, and BLM lands adjacent to the forest. Treatment tools on these lands are not as limited as they are on the forest. There is more opportunity to maintain and improve weed-invaded habitat for these two species in the long-term. However, there is also a higher probability for these non-forest lands to be reinvaded annually by weeds from the forest.

The inability to aerially apply herbicides to control cheatgrass would have negative consequences to some vesper sparrow and plains sharp-tailed grouse habitat in more inaccessible areas. Cheatgrass would be able to expand in these areas and reduce or eliminate habitat for these two species. Over time, noticeable changes in habitat due to invasive species (for example, cheatgrass expansion in shrublands) could cause population declines for these two species on the forest.

Livestock and wildlife use of upland habitat could lead to a reduction in quality or quantity of vesper sparrow and plains sharp-tailed grouse habitat in the long-term. Annual rangeland monitoring and adherence to forest plan livestock grazing guidelines ensure that upland habitat is maintained in the long-term.

Habitat loss and fragmentation from energy development are also factors affecting sharp-tailed grouse populations. Vodehnal and Haufler (2007) noted that energy development and its infrastructure are primary issues affecting sharp-tailed grouse populations.

Forest Plan Consistency

Relevant standards and guidelines for the forest and grassland plans were reviewed. The effects of the four alternatives and the protection measures in appendix A were evaluated to determine if they were consistent with forest and grassland plan direction. The alternatives will meet the standards and guidelines when the resource protection measures in appendix A are applied.

Issue #3 Soil, Water, and Aquatic Resources, Including Fisheries

Affected Environment

Soil: The analysis focused on soil permeability which is used by the states of Colorado and Wyoming to describe soil sensitivity to groundwater contamination by pesticides.

Soils on the TBNG tend to be alkaline, relatively low in organic matter, and are finer grained and more prone to surface-precipitation runoff compared to the soils in adjacent mountains (Lowry et al. 1986). Mean infiltration rates measured from field tests of natural soils in Colorado, Montana, and Wyoming ranged from about 95 millimeters (mm) per hour for sandy-soil types to 14.7 mm per hour for shale-soil types (McQueen 1963).

Soils in the montane portions (~ 8,000-11,000 feet elevation) of the Little Snake River, Yampa River, North Platte River, Laramie River, and Medicine Bow River basins have permeability rates that range from 1.5 mm per hour to 152 mm per hour (Driver et al. 1984). Soils at higher elevations (greater than 11,000 feet) have permeability rates that range from 5.0 mm per hour to about 152 mm per hour (Kuhn et al. 1984).

Water quality: Source waters such as rivers, streams, wells, and intakes are vital sources of domestic and municipal water supplies in Colorado and Wyoming. NFS lands comprise more than seventy percent of the delineated, source water areas in Colorado. The surface water quality in rivers, streams, lakes, ponds, and reservoirs on the Medicine Bow and Routt national forests are typically in compliance with federal and state water quality standards. Groundwater sensitivities in the project area have not been assessed and mapped.

Water quality conditions in streams, lakes, and reservoirs located in the Mount Zirkel, Never Summer, Platte River, Sarvis Creek, and Flat Tops wildernesses are classified as outstanding by the state of Colorado (Colorado Department of Public Health and the Environment 2012). Streams outside the wilderness areas appear to exhibit water quality conditions that comply with state and federal standards. None of the streams located in the Routt National Forest has been listed by the Colorado Department of Public Health and the Environment as impaired due to pesticide contamination.

Based on water quality sampling conducted through 2012, water quality conditions in the Medicine Bow and Routt national forests and the Thunder Basin National Grassland appear to be typical to outstanding, with the exception of two stream segments on the Pole Mountain unit of the Medicine Bow National Forest. None of the forest and grassland streams has been listed by the state as impaired due to pesticide contamination.

The states of Colorado and Wyoming have implemented protocols to monitor groundwater contamination by agricultural chemicals, including herbicides; however, these protocols do not include NFS lands because they are considered to be low priority for monitoring in both states.

The forest plan for the Routt National Forest designates management prescription area (MPA) 3.23 as an area where the management emphasis is municipal watersheds. This MPA encompasses about 16,200 acres located primarily in the Fish Creek watershed, including Fish Creek Reservoir and Long Lake. Forest plan direction prohibits the use of chemical treatments in this MPA. The Medicine Bow National Forest and Thunder Basin National Grassland plans do not address municipal watersheds.

Aquatic organisms and amphibians: Native and non-native fish known or suspected to occur in the MBRTB have adapted to a variety of subalpine, montane, and grassland aquatic, riparian ecosystems. The federally listed species, R2 sensitive aquatic species, and management indicator species (MIS) known or suspected to occur in the project area are listed in the following table.

Table 19. Aquatic organisms and amphibians in the project area and their status.

Species	Status
Lineage greenback cutthroat trout (RNF)	Threatened
Colorado River cutthroat trout (MBRNF)	Sensitive and MIS
Mountain sucker (MBRNF)	Sensitive
Hornyhead chub (MBRNF)	Sensitive
Flathead chub (TBNG)	Sensitive
Plains minnow (TBNG)	Sensitive
Sturgeon chub (TBNG, one unconfirmed observation)	Sensitive
Boreal toad (MBRNF)	Sensitive
Northern leopard frog (MBRTB)	Sensitive
Wood frog (MBRNF)	Sensitive
Rocky Mountain capshell snail (MBRNF)	Sensitive
Hudsonian emerald dragonfly (MBRNF)	Sensitive
Brook trout (MBRNF)	MIS
Brown trout (MBRNF)	MIS
Rainbow trout (MBRNF)	MIS

RNF – Routt National Forest, MBNF – Medicine Bow National Forest, MBRNF – Medicine Bow and Routt national forests, TBNG – Thunder Basin National Grassland

Lineage greenback cutthroat trout: Prior to January 28, 2014, three lineage greenback cutthroat trout populations were documented on the Routt National Forest (Deadman Gulch) and on Arapaho National Forest lands (Antelope Creek and Carter Creek) administered by the Parks Ranger District (Routt NF). On January 28, 2014, results of genetic analyses revealed a fourth lineage greenback cutthroat trout population in Buffalo Creek on the Parks Ranger District.

Colorado River cutthroat trout (CRCT) are typically found in headwater streams in the Little Snake River and Yampa River basins within the analysis area; the distribution of this species has been dramatically reduced because of the introductions of non-native trout. The preferred habitat of the CRCT is deep pools, although their preferred spawning habitat is similar to that of other trout: mild, riffle habitats (Baxter and Stone 1995).

Mountain suckers can be found in lower-elevation montane rivers and streams in the MBRNF, especially in those systems west of the Continental Divide. They feed primarily on algae and aquatic invertebrates.

Hornyhead chubs are now quite rare in the Laramie River and are found in the MBRNF only in the North Laramie River. Hornyhead chubs prefer stream habitats with clear water and gravel-bottom substrate. They forage on a variety of aquatic and terrestrial insects in addition to crustaceans and molluscs.

Flathead chubs are native to the TBNG analysis area and well adapted to its aquatic conditions. Baxter and Stone (1995) described the flathead chub as well adapted to fast waters (20-60 cm/sec.) in turbid rivers and streams. Additionally, this species prefers habitats with sand and gravel substrates.

Plains minnows have been collected during fish surveys in the TBNG. Plains minnows prefer low-velocity habitats in turbid streams, although the species is sometimes found in clear waters. According to Baxter and Stone (1995), the plains minnow is primarily herbivorous, although it will feed on aquatic insect larvae.

Sturgeon chubs are found in the Powder River and Little Powder River basins in Wyoming. There is one likely, but unconfirmed, observation in the Little Powder River. Because this species prefers main channel habitats in large rivers of the Great Plains, it may not persist in viable numbers in the Little Powder River. No published fish surveys have definitively documented the presence of this species on the TBNG.

Boreal toads seem to prefer the backwaters of streams, the shoreline areas of ponds, and wet meadow habitats on the MBRNF. The few active breeding sites on the forest have been associated with beaver-dam complexes and adjacent wetlands, and breeding generally occurs mid May through June. Boreal toads are relatively rare throughout the forest.

Northern leopard frogs are native to the MBRTB and are one of two native ranid (true frog) species in the analysis area. They require diverse habitats in proximity to support at least three life history stages: adults, tadpoles, and juveniles (Smith and Keinath 2007).

Wood frogs are found in several disjunct populations on the MBRNF located entirely within the North Platte River basin. Wood frogs prefer riparian and wetland habitats located in the montane zone and are seldom found away from water (Baxter and Stone 1992, Stebbins 1985).

Rocky Mountain capshell snails prefer cold lakes in montane and subalpine environments. The only suspected location on the MBRNF is Big Creek Lakes. Not much is known about this species' population trends. In a northern Colorado survey, most snails were found in lakes below 9,400 feet elevation. They seem to prefer waters with higher calcium (104.0 mg/L) content and higher conductivity (39.0 micromohs/cm). Adult snails are found attached to rocks, wood, or vegetation (Anderson 2005).

Hudsonian emerald dragonflies appear to be extremely rare in the MBRNF. There are only two records that document observations in the MBRNF: one specimen from the Medicine Bow Mountains that was collected in 1937 and four specimens collected in 1978 from the North Fork, Little Laramie River in the Snowy Range (Packauskas 2005). This species prefers lakes, ponds, and wetland habitats in the MBRNF such as lakes that have sedge shoreline zones and well-aerated, boggy ponds in the montane. The larvae prefer lakes, ponds, and wetland habitats that exhibit good (well-oxygenated) water quality.

Environmental Effects

Effects from Biological, Mechanical, and Cultural Treatments Common to All Alternatives

The non-herbicide treatments proposed under all alternatives would have negligible effects on soils, water resources, and aquatic organisms. Release of biological control agents would have no direct effect on fisheries or surface water quality. These agents would not compete with aquatic insect species since their food base is very specific nor would they provide more than an incidental food source for fish.

Mechanical treatments could result in localized soil disturbance, but an increase in sediment to streams would likely be undetectable for several reasons. Disturbed areas would be minimal and localized and would be reseeded with desirable species after treatment, reducing erosion as roots become established. Mechanical treatments such as grazing, burning, and mowing could affect suspended sediments, total dissolved solids, or water temperature. Physical restrictions on tilling (such as steep slopes) would prevent significant impacts to water quality. Small-scale tilling for weed control, with streamside buffer strips, could benefit water quality. The tilling action breaks the ground surface and allows a greater infiltration rate. Infiltration rates vary with soil types and slopes. Terrain restrictions and the scattered nature of weeds do not allow widespread use of this technique.

Cultural treatments (seeding, transplanting, and fertilizing) would not affect fisheries or water quality. Fertilizers would be applied according to Forest Service and manufacturer guidelines. Nutrient concentrations in runoff would not be large enough to measurably enrich streams. Seeding and transplanting would involve limited soil disturbance.

Grazing with sheep or goats to control selected weeds would produce little effect on overall water quality, although trampling within the stream channels might temporarily degrade water quality. Water quality indicators such as coliform numbers might increase and, in shallow streams, might exceed drinking water standards. These possible short exceedance periods would correct following livestock removal.

Prescribed burning has the potential to increase sediment in streams. Burning removes top vegetation until the next growing season or fall green up. This removal of vegetation cover would increase the potential of surface runoff and might increase suspended sediment and total dissolved solids levels in the streams until regrowth occurs. The amount of sediment reaching streams is generally proportional to the amount of bare soil in a watershed. The size of the impact from a treatment would depend on the amount of exposed soil, the severity of the burn, and the distance to the nearest stream.

Lack of effective invasive species treatment would likely result in invasive plants, particularly cheatgrass, displacing native plant communities. Aquatic and soil ecosystems and water quality could then be negatively impacted indirectly if the expansion of cheatgrass increases the incidence of wildfire. An increase in wildfires could result in an increase in stream sedimentation as well as an increase in ash input. Runoff and sedimentation could also increase because invasive species generally provide less effective ground cover. Increased sedimentation could affect all the species discussed in this analysis as water quality degradation often results in mortality to aquatic biota.

Effects from Herbicide Treatments under Alternatives 1, 2, and 3

The potential for effects to water quality and aquatic organisms is largely associated with herbicide application on and around streams, lakes or wetlands. Contamination can occur through direct herbicide contact with surface water from either inadvertent application or accidental spill. Risks vary with the persistence of active ingredients, soil and vegetation characteristics and condition, and the intensity and timing of precipitation events following herbicide application.

Leaching through the soil profile is also a routing mechanism but generally poses the least risk to aquatic environments. While there are exceptions, most herbicides disappear quickly from both the ground surface and soil.

Most groundwater contamination by herbicides results from point sources such as spills and leaks at storage and handling facilities, improperly discarded containers, or rinsing equipment at inappropriate locations. Point sources are generally discrete, identifiable locations that discharge relatively high local concentrations of herbicides. Such problems can be avoided with implementation of the protection measures that require proper handling of herbicide containers and application equipment.

Protection measures in appendix A are designed to reduce the potential for water contamination. Table A-1 discusses how specific herbicides would be used (or not used) near surface waters, shallow ground water, and domestic water supplies. The protection measures take into account the specific properties of each herbicide.

Municipal water sources are protected from herbicide contamination under these alternatives by the forest plan standards and guidelines (Routt NF) that prevent chemical treatment within designated municipal watersheds and the resource protection measures in appendix A designed to protect water resources (Routt and Medicine Bow NFs and TBNG). These include the requirement for an herbicide emergency spill plan which would address measures to be taken if an accidental spill should occur.

Alternative 1 (Current Management) – Direct and Indirect Effects

The effects discussed in the preceding section apply to this alternative. Because aircraft would not be used for herbicide application, this alternative would have less risk of a catastrophic herbicide spill which could contaminate water.

This alternative has the potential for adverse soil and water impacts because of reduced ability to effectively treat invasive species, cheatgrass in particular. Invasive species are generally less effective groundcover than native plants. Less effective ground cover increases the potential for surface erosion and reduces the amount of moisture in the soil due to an increase in exposed soil surface (Olson 1999). A monoculture of cheatgrass can also increase the incidence of wildfire and subsequent erosion and sedimentation. If the increase in invasive species affects water quality (e.g., increased surface erosion and sedimentation), aquatic organisms could be affected as water quality degradation often results in mortality to aquatic biota.

Effects of the following herbicides are discussed under alternative 2: chlorsulfuron, clopyralid, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr and 2,4-D. Those effects also apply under alternative 1.

Effects determination for lineage greenback cutthroat trout and sensitive aquatic species: There is a slight risk of effects to the following species: Rocky Mountain capshell snail, Hudsonian emerald dragonfly, boreal toad, northern leopard frog, wood frog, mountain sucker, Colorado River cutthroat trout, flathead chub, hornyhead chub, sturgeon chub, and plains minnow.

The actions that would be implemented under alternative 1 would result in a determination of *no effect* for lineage greenback cutthroat trout and *may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability rangewide* for the eleven sensitive species. The determinations are based on the following:

- There is no documented, compelling evidence to suggest the existing noxious farm weed management program on the Parks and Yampa ranger districts has had, or will have, adverse effects on greenback cutthroat trout populations and habitats.
- The probability of the resource protection measures being effective in protecting occurrences of these species is very high.
- The possibility of individuals being inadvertently impacted during treatment is slight but does exist.
- There is a risk of increased weed infestation resulting from less effective weed control which could degrade species habitat.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

The effects of biological, mechanical, cultural, and ground-based herbicide treatments (discussed previously) apply to alternative 2.

Invasive species management under alternative 2 is expected to have a beneficial effect on soils in the project area by increasing groundcover and reducing surface erosion. Under alternative 2, invasive species populations would decrease and native plant populations would increase (Haas 2013). Native plants generally provide more effective groundcover than invasive plants, and more effective groundcover reduces surface erosion. Reduced surface erosion benefits soil ecosystems and aquatic ecosystems because improvement in water quality is expected.

Syracuse Environmental Research Associate’s (SERA’s) risk assessments considered two potential effects of herbicide use on soils: herbicide effects on soil microorganisms and water quality impacts due to runoff of soils contaminated with herbicides. SERA risk assessments also determined potential effects to aquatic organisms from herbicide use. These effects are summarized in the following table. The effects summary for triclopyr is separated into three parts based on the two forms of the herbicide that are used commercially (triclopyr TEA and triclopyr BEE) and by the major metabolite (TCP). This separation is necessary because the effects may be different depending on the aquatic organism.

According to the SERA (2003-2007), none of the herbicides proposed for use are expected to have long-lasting effects on soil microorganisms so soil productivity is expected to remain unchanged. The potential for water quality impacts varies depending on the herbicide, soil properties, and rainfall.

The potential for water quality impacts from herbicide use under this alternative is reduced with implementation of the protection measures in appendix A. There are general measures to prevent the potential contamination of any perennial or intermittent waterway, unprotected ephemeral waterway or wetland; protection measures specific to water resources; protection measures for wildlife/aquatics and water and woodlands; and protection measures for environmentally sensitive areas that describe application restrictions for specific herbicides.

For example, in areas with high or unacceptable risk of groundwater contamination, broadcast application of clopyralid, dicamba, hexazinone or picloram is not allowed. Ester formulations of herbicides (2, 4-D ester, triclopyr ester) are prohibited in streamside or wetland areas where fisheries and aquatic-dependent (i.e. tadpoles) amphibian life stages occur. Table A-1 in appendix A lists specific herbicides and application methods allowed in aquatic, streamside, wetland, and groundwater zones. There are also specific protection measures for aerial application of herbicides.

Table 20. Estimated effects of proposed herbicide use on soil, soil organisms, and aquatic organisms (SERA 2003-2011).

Herbicide	Effects to Soil, Soil Organisms, and Aquatic Organisms
2,4-D	Under arid conditions (i.e., annual rainfall of about 10 inches or less), there is no, or very little, runoff. At higher rainfall rates, runoff losses range from negligible to about 50% of the application rate, depending on the amount of rainfall and soil type. Could have a transient impact on algae in the soil when applied at rates at or above those used by the Forest Service. Effects to other soil microorganisms seem less likely according to other studies. Over the range of 2,4-D acid/salt application rates used in Forest Service programs (0.5 to 4 lb a.e./acre), adverse effects on fish, amphibians, and aquatic invertebrates are likely only in the event of an accidental spill. With regard to 2,4-D esters, adverse effects on aquatic animals (fish, invertebrates, amphibians) are plausible in association with runoff (all application rates) and in cases of relatively large accidental spills. Longer term exposure to 2,4-D concentrations associated with inadvertent contamination of water by runoff could affect sensitive species of aquatic macrophytes at the upper range of the application rates used in Forest Service programs. Damage to aquatic vegetation, particularly aquatic macrophytes, is likely in the event of an accidental spill.
Aminopyralid	Except in areas that are highly susceptible to runoff such as hard-packed and predominantly clay soils, offsite losses associated with runoff do not appear to pose a substantial risk [to sensitive plants]. Runoff of about 1% to 5% of the applied aminopyralid from predominantly clay soils might be expected depending on rainfall rates. Much less runoff is expected from loam soils and virtually no runoff is expected from predominantly sand soils. Few studies address the effects of aminopyralid on soil microorganisms, but there does not appear to be a basis for suggesting that adverse effects are plausible. Aminopyralid has been shown to be practically non-toxic to fish and aquatic invertebrates. It is slightly toxic to eastern oyster, algae, and aquatic vascular plants. Aminopyralid is not expected to build up in fish tissue. There are no acute or chronic risks to non-target endangered or non-endangered fish, birds, wild mammals, terrestrial and aquatic invertebrates, algae, or aquatic plants.

Herbicide	Effects to Soil, Soil Organisms, and Aquatic Organisms
Chlorsulfuron	Runoff will be negligible in relatively arid environments as well as sandy or loam soils. In clay soils, which have the highest runoff potential, off-site loss may reach up to about 55% of the applied amount in regions with very high rainfall rates. There is no basis for asserting that chlorsulfuron is likely to cause adverse effects in soil microorganisms under the conditions of application covered in this analysis. Chlorsulfuron appears to have a very low potential to cause any adverse effects in aquatic animals. All of the hazard quotients for aquatic animals are extremely low. At the maximum application rate of 0.25 lbs/acre, the risk characterization is below the level of concern by a factor of 200. At the typical application rate, peak concentrations of chlorsulfuron in water could result in damage to aquatic macrophytes – i.e., hazard quotients ranging from 1.2 to about 24 based on a concentration causing 50% inhibition of growth. Thus, if chlorsulfuron is applied in areas where transport to water containing aquatic macrophytes is likely, detectable damage would be. Aquatic algae do not appear to be as sensitive to chlorsulfuron; the hazard quotient is only modestly above the level of concern.
Clopyralid	Clopyralid does not bind tightly to soil; however, the potential for leaching or runoff is functionally reduced by its relatively rapid degradation. Leitch and Fagg (1985) monitored a maximum concentration 0.017 mg/L in stream water following a 5.2 inches of rain after the application of clopyralid at a rate of 1.90 lb a.e./acre to predominately clay-loam soil. While the available toxicity data on soil organisms are limited, the projected maximum concentrations in soil are far below potentially toxic levels. Clopyralid appears to have low potential to cause adverse effects in any aquatic species. However, data is available on relatively few animal and plant species compared to the number of species that could potentially be exposed.
Dicamba	Runoff will be negligible in relatively arid environments, as well as sandy or loam soils. In clay soils, which have the highest runoff potential, off-site loss may reach up to about 3.5% of the applied amount in regions with very high rainfall rates. Peak soil concentrations in the range of about 3.5 (sand and loam) to 4 ppm (clay) are likely immediately after at an application rate of 1 lb a.e./acre regardless of rainfall rates. Longer term concentrations in soil vary with rainfall rates and range from about 0.3 ppm in very arid soils to about 0.01 ppm in regions with high rainfall rates. There is very little indication that dicamba will adversely affect soil microorganisms. Lack of data on chronic exposure imposes serious limitations on the ability to characterize long-term risk for aquatic organisms. The limited available data suggests that salmonids are more sensitive than other freshwater fish to the acute toxicity of dicamba, and rainbow trout (*Oncorhynchus mykiss*) was the most sensitive species. Studies report little or no toxicity to mosquito fish and bluegill sunfish but some mortality among three species of *Cyprinidae*. Amphibians appear to be as tolerant as fish to the acute toxicity of dicamba. Some invertebrates appear to be somewhat more sensitive than fish and amphibians to the acute toxicity of dicamba.

Herbicide	**Effects to Soil, Soil Organisms, and Aquatic Organisms**
Fluroxypyr	Runoff of up to about 10% of applied fluroxypyr may occur in predominantly clay soils with high rates of rainfall. Much less runoff is expected from loam soils, and virtually no runoff is expected from predominantly sand soils. Studies on the toxicity of fluroxypyr to terrestrial microorganisms are lacking. Applications of the fluroxypyr formulations considered in the risk assessment do not appear to present a risk to tolerant or sensitive species of fish, tolerant species of aquatic invertebrates (crustaceans), or tolerant species of algae and aquatic macrophytes.
Glyphosate	In general, glyphosate will bind tightly to soil, and its leaching capacity is extremely low. The upper bound of 0.089 lb a.e./acre is the highest runoff proportion for an area with predominantly clay soils, cool temperatures, and high rainfall. The lower bound value of 0.0000001 lb a.e./acre would be expected in arid areas with predominantly loam or sandy soils. There is very little information suggesting that glyphosate will be harmful to soil microorganisms under field conditions and a substantial body of information indicating that glyphosate is likely to enhance or have no effect on soil microorganisms. The primary hazards to fish appear to be from acute exposures to the more toxic formulations. The risk characterization strongly suggests that the use of the more toxic formulations near surface water is not prudent. Use of glyphosate near bodies of water where sensitive species of fish may be found (i.e., salmonids) should be conducted with substantial care to avoid contamination of surface water. Concern for potential effects on salmonids is augmented by the potential effects of low concentrations of glyphosate on algal populations.
Hexazinone	The potential for offsite movement appears to be high for predominately clay soils. In loam, much less offsite transport is modeled. In predominantly sandy soils, the major transport mechanism is percolation into the soil with little risk of offsite loss due to runoff or sediment loss. No effects to soil organisms were noted, even when hexazinone was applied at a much higher rate than would be used in the project area. Most algal species are much more sensitive to hexazinone than fish and aquatic invertebrates. Aquatic macrophytes also may be very sensitive to the toxic effects of hexazinone. This assumes the effects to aquatic macrophytes are similar to the effects to terrestrial plants. Other than lethality, the most common effect noted on aquatic animals is growth inhibition, which is also the most sensitive effect in experimental mammals. Only one study regarding amphibians was located, and it suggests that amphibians are less sensitive than fish or aquatic invertebrates to hexazinone.

Herbicide	Effects to Soil, Soil Organisms, and Aquatic Organisms
Imazapic	Runoff will be negligible in relatively arid environments as well as sandy or loam soils. In clay soils, which have the highest runoff potential, off-site loss may reach up to about 3.5% of the applied amount in regions with very high rainfall rates. No data are available on effects of imazapic on soil invertebrates or soil microorganisms. Evidence suggests no adverse effects in fish or aquatic invertebrates using typical or worst-case exposure assumptions at the typical application rate of 0.1 lb/acre or the maximum application rate of 0.1875 lb/acre. Aquatic animals appear to be relatively insensitive to imazapic exposures for both acute toxicity and reproductive effects. In acute toxicity studies, all tested species (channel catfish, bluegill, sunfish, trout, and sheepshead minnow) evidenced relatively low toxicity. No effects on reproductive parameters were seen in a 32-day egg and fry study using fathead minnow. In acute toxicity studies with aquatic invertebrates, no adverse effects were observed at concentrations of imazapic of up to 100 mg/L. Aquatic plants, particularly macrophytes, are much more sensitive to imazapic exposure than aquatic animals. Nonetheless, hazard quotients for unicellular algae are substantially below a level of concern with either acute or chronic exposure. Macrophytes appear to be more sensitive to imazapic than unicellular algae, and at peak concentrations, some damage to macrophytes is plausible. No toxicity studies have been located on the effects of imazapic on amphibians or microorganisms.
Imazapyr	Imazapyr may persist in soil for a prolonged period of time, particularly in relatively arid regions and will not bind tightly to alkaline soils with low organic matter. In areas with predominantly sandy soils, the runoff of imazapyr following foliar applications should be negligible. Risks will be greatest in areas with predominantly clay soils and moderate to high rates of rainfall. Risks may also be relatively high in cool locations with predominantly loam soils. There does not appear to be any basis for asserting that imazapyr is likely to adversely affect microorganisms in soil. Evidence suggests no adverse effects in fish or aquatic invertebrates are plausible using typical or worst-case exposure assumptions at the typical application rate of 0.45 lb/acre or the maximum application rate of 1.25 lb/acre. However, imazapyr has only been tested on a limited number of species and under conditions that may not represent populations of free-ranging nontarget animals.
Methsulfuron methyl	The offsite movement of metsulfuron methyl via runoff could be substantial under conditions that favor runoff – i.e., clay soils and high annual rainfall. Off-site loss may reach up to 60% of the applied amount in regions with very high rainfall rates. Soil microorganisms are sensitive to metsulfuron methyl at concentrations of 5 ppm. Most effects on soil microorganisms appear to be transient. Metsulfuron methyl appears to have a very low potential to cause any adverse effects in aquatic animals. All of the hazard quotients for aquatic animals are extremely low. However, confidence in the risk characterization is reduced by the lack of chronic toxicity studies in potentially tolerant fish. At the maximum application rate of 0.15 lbs/acre, all of the hazard quotients would be increased by a factor of about 5. However, this difference has no impact on the risk characterization for fish.

Herbicide	Effects to Soil, Soil Organisms, and Aquatic Organisms
Picloram	Technical grade picloram contains low concentrations (3 ppm or less) of hexachlorobenzene (a carcinogen). Hexachlorobenzene is highly persistent in soil with metabolic half-lives of about 3 to 6 years. Conversely, hexachlorobenzene is relatively volatile and is expected to dissipate rapidly from soil surfaces. SERA estimated the simple first-order dissipation rate for hexachlorobenzene in the top one inch of soil at 0.0084 day^{-1} which corresponds to a half-life of about 80 days. The contamination of surface water following applications of picloram is expected to be minimal in relatively arid areas and even areas with normal rainfall, particularly in locations with predominantly loam or sandy soils. Watson et al. (1989) found no picloram in a stream after the application at rates of about 0.25 lb/acre in areas with loam or sandy loam soil. Although picloram could have an effect on soil microorganisms, the consequences of such effects are not clear. Picloram has been used as an herbicide since 1964 (U.S. EPA 1995b). No field studies linking adverse effects on soil microorganism with detectable adverse impacts on soil productivity have been encountered. None of the hazard indices for fish, aquatic invertebrates, or aquatic plants reach a level of concern. There is substantial variability in toxicity to aquatic species; however, it has no substantial impact on the risk characterization. The risk characterization for both terrestrial and aquatic species is limited by the relatively few animal and plant species on which data are available compared to the large number of species that could potentially be exposed.
Sulfometuron methyl	Studies by Hubbard et al. (1989) and Wauchope et al. (1990) generally support the supposition that at least 1% of the applied sulfometuron methyl could run off from the application site to adjoining areas after a moderate rain. In the case of a heavy rain, losses could be much greater and might approach 50% in cases of extremely heavy rain and a steep soil slope. Sulfometuron methyl applied at rates that control undesirable vegetation will cause substantial damage to target or nontarget vegetation. This damage would probably be accompanied by secondary changes in the local environment affecting the soil microbial community to a greater extent or at least more certainly than any direct toxic action by sulfometuron methyl on the microorganisms. Data regarding the toxicity of soil-incorporated sulfometuron methyl is not available. Sulfometuron methyl appears to have a low potential to cause adverse effects in aquatic animals. All of the hazard quotients for aquatic animals are extremely low. Confidence in this risk characterization is reduced by the lack of chronic toxicity studies in potentially tolerant fish and potentially sensitive aquatic invertebrates and lack of data in amphibians (data only available in a single species).
Triclopyr	In all sets of simulations (each simulation consisted of 9 locations with 3 soil textures per location), the expected concentrations of triclopyr, triclopyr BEE, and TCP in surface water were zero even at the upper bounds for locations with little rainfall. Even in locations with moderate to heavy rainfall, many individual simulations yield central estimates of concentrations in surface water that are zero or nearly so This is also the case for sites with average rainfall and sand soil textures as well as sites with loam soil textures and cool temperatures.

Herbicide	Effects to Soil, Soil Organisms, and Aquatic Organisms
Triclopyr, cont.	Laboratory studies suggest a very high degree of variability in the response of soil bacteria and fungi to triclopyr. If those studies are used to characterize risk, then short-term growth inhibition of some bacteria or fungi might be expected; but gross changes in the capacity of soil to support vegetation do not seem plausible.
Triclopyr TEA	For terrestrial applications of triclopyr TEA, no risks to fish, amphibians, or aquatic invertebrates are identified, based on expected peak concentrations or longer-term concentrations of triclopyr acid in surface water. At terrestrial application rates of 1.5 lbs a.e./acre, the hazard quotients for sensitive species of algae reach, but do not exceed, the level of concern. The likelihood of significant surface water contamination due to runoff is remote in arid areas. With terrestrial applications of triclopyr TEA, risks to aquatic macrophytes are substantial. As with algae, these risks will be much less in arid areas, so long as drift to surface water is avoided.
Triclopyr BEE	Triclopyr BEE hydrolyzes rapidly in soil; the estimated half-life of 0.2 days is conservative. Longer-term water concentrations of triclopyr BEE in surface water are extremely low, with central estimates of longer-term concentrations in surface water at or below 2 ppt (0.0018 µg/L). Application rates of triclopyr BEE of less than 3 lbs a.e./acre are not likely to pose risks to fish or amphibians. For higher application rates, consideration of local site conditions would be required to assess the possibility of risks to fish. Low longer-term hazard quotients for triclopyr BEE suggest no species of fish are likely to be at risk from chronic exposures to triclopyr BEE. For aquatic invertebrates, the hazard quotient would reach a level of concern at application rates of approximately 1.5 lbs a.e./acre. The upper bound hazard quotient for longer-term exposures suggests that the low longer-term concentrations of triclopyr BEE in surface water will not pose a risk to aquatic invertebrates. Any application of triclopyr BEE could result in adverse effects in algae in areas where substantial drift or offsite movement in runoff is likely. With terrestrial applications of triclopyr BEE, risks to aquatic macrophytes are substantial. As with algae, these risks will be much less in arid areas, so long as drift to surface water is avoided.
TCP	At application rates of up to 5 lb a.e./acre, TCP is not likely to pose a risk to sensitive species of fish, and longer-term concentrations of TCP are far below the level of concern. The potential impact of TCP on amphibians is not assessed because of the lack of data on the toxicity of TCP to amphibians. Risks associated with exposures of aquatic invertebrates to TCP following terrestrial applications are far below the level of concern.

Aerial spraying near aquatic zones has the most potential to affect water quality, either through direct application or drift. The greater potential for effects is due to the inability to target exact locations or completely control herbicide drift, both of which can result in unnecessary or inaccurate application of herbicides. There are resource protection measures in place to help reduce the potential for effects, including requiring a 300-foot buffer on each side of aquatic, streamside, or wetland areas and multiple measures designed to reduce spray drift. There are also resource protection measures that require a surface water quality risk assessment with site-specific information during the contract preparation for aerial application of herbicides, adding another layer of protection for surface water.

Herbicide drift is not expected to be environmentally deleterious over time. Herbicide residues on plants chemically decompose when exposed to sunlight and tend to have relatively short residence times in the environment. Herbicide residues are also subject to microbial decomposition in humus and mineral soils. During base flow conditions, herbicide residue entering the aquatic environment is diluted which would result in a dose lower than the threshold identified in the risk assessments.

The potential for catastrophic herbicide spills, which could contaminate soil and water, would be higher under this alternative because aircraft may be used for herbicide application. When an aircraft is involved, there is the potential, albeit small, for a crash that would result in a mixture of aviation fuel and herbicide. Such a crash could form a more environmentally destructive mixture than either chemical or fuel alone. Appendix A contains a protection measure that requires the development and implementation of an herbicide emergency spill plan.

Effects determination for lineage greenback cutthroat trout and sensitive aquatic species: There is a slight risk of effects to the following species: Rocky Mountain capshell snail, Hudsonian emerald dragonfly, boreal toad, northern leopard frog, wood frog, mountain sucker, Colorado River cutthroat trout, flathead chub, hornyhead chub, sturgeon chub, and plains minnow.

The actions that would be implemented under alternative 2 result in a determination of *no effect* for lineage greenback cutthroat trout and a determination of *may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability rangewide* for the eleven sensitive species. The determinations are based on the following:

- The current weed treatment program is not adversely affecting greenback cutthroat trout populations on the Parks and Yampa ranger districts, so it is unlikely a more effective weed treatment program would negatively impact populations or habitats on the two districts.
- The probability of the resource protection measures being effective in protecting occurrences of these species is very high.
- The possibility of individuals being inadvertently impacted during herbicide treatment is very slight but does exist.

Alternative 3 (No Aerial Application) – Direct and Indirect Effects

Effects under alternative 3 are expected to be similar to those discussed for alternative 2 with the following exceptions:

- Effects from aerial application would not apply.
- Under alternative 3, fewer infested acres could be treated with herbicide annually, resulting in less herbicide being applied across the landscape compared to alternative 2. That would effectively reduce the risks to water quality and aquatic organisms from those described for alternative 2.
- Because this alternative does not provide an effective tool for managing cheatgrass, there is potential for effects to soil, water quality, and aquatic organisms due to wildfire as discussed under alternative 1.
- There would be less potential for impacting source water areas as these areas are delineated and could therefore be more effectively avoided than with aerial application.
- Small unmapped wet areas of shallow water tables or groundwater-dependent ecosystems are less likely to be inadvertently sprayed with herbicide because hand application provides much more control. This would decrease the potential for impacts to water quality and aquatic organisms.

Effects determination for lineage greenback cutthroat trout and sensitive aquatic species: There is a slight risk of effects to the following species: Rocky Mountain capshell snail, Hudsonian emerald dragonfly, boreal toad, northern leopard frog, wood frog, mountain sucker, Colorado River cutthroat trout, flathead chub, hornyhead chub, sturgeon chub, and plains minnow.

The actions that would be implemented under alternative 3 would result in a determination of *no effect* for lineage greenback cutthroat trout and a determination of *may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability rangewide* for the eleven sensitive species. The determinations are based on the following:

- The current weed treatment program is not adversely affecting greenback cutthroat trout populations on the Parks and Yampa ranger districts, so it is unlikely a more effective weed treatment program would negatively impact populations or habitats on the two districts.
- The probability of the resource protection measures being effective in protecting occurrences of these species is very high.
- The possibility of individuals being inadvertently impacted during treatment is very slight but does exist.
- There is a risk of increased weed infestation resulting from less effective weed control which could degrade species habitat.

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

Effects from alternative 4 were described previously in the *Effects from Biological, Mechanical, and Cultural Treatments* section.

Effects determination for lineage greenback cutthroat trout and sensitive aquatic species: There is a slight risk of effects to the following species: Rocky Mountain capshell snail, Hudsonian emerald dragonfly, boreal toad, northern leopard frog, wood frog, mountain sucker, Colorado River cutthroat trout, flathead chub, hornyhead chub, sturgeon chub, and plains minnow.

The actions that would be implemented under alternative 4 would result in a determination of *no effect* for lineage greenback cutthroat trout and a determination of *may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability rangewide* for the eleven sensitive species. The determinations are based on the following:

- There would be no impacts from herbicides use. There is, however, uncertainty about how existing invasions of non-native plants and future invasions may affect these species because the existing invasive species are not likely to be controlled without the use of herbicides. Less effective weed control could increase weed infestations and degrade species habitat.
- The probability of the resource protection measures being effective in protecting occurrences of these species is very high.
- The possibility of individuals being inadvertently impacted during or following mechanical treatment is very slight but does exist.

Cumulative Effects

The activities and effects listed in the following table were considered in the cumulative affect analysis for aquatic and wetland ecosystems.

Table 21. Activities considered in the cumulative effects analysis for soil, water, and aquatic resources.

Activity	Effects
Livestock grazing	Bank alteration, stream channel over-widening, sediment introduction, loss of riparian vegetation
Timber harvesting	Sediment introduction, reduction of woody debris recruitment potential, modified water temperature regimes
Road construction and reconstruction	Sediment introduction, migration barriers
Dams and diversions	Altered water temperatures, fish migration barriers, altered sediment transportation, altered aquatic communities, altered flow regimes, reduction of instream flows
Mining	Water quality impacts associated with acid mine drainage, contaminated sediment from tailings
Oil and gas exploration and development	Sediment introduction from road construction and other disturbed sites, water quality contamination from spills or container failure, potential groundwater contamination, groundwater pumping and wastewater disposal
Urbanization	Increased runoff from loss of infiltration, water quality impacts from transport of contaminants from paved or hardened surfaces

Under alternatives 1, 2, and 3, there is potential for herbicides to be introduced into streams and ponds via runoff. Activities that cause ground disturbance or reduce ground cover could cause more runoff and thus increase the potential for herbicides to be transported into water sources. This could impact aquatic organisms depending on the herbicide used. For example, both triclopyr TEA and imazapic can damage aquatic plants, and some fish species (salmonids) are sensitive to dicamba and glyphosate.

Alternative 2 could have the greatest cumulative impact on water quality, and potentially to aquatic organisms, due to the potential for drift from aerial herbicide application added to water quality impacts from the actions listed in the table above. As noted in Table 20, damage to aquatic plants is plausible with imazapic, the herbicide initially proposed for use in aerial treatments.

There is also the potential for a cumulative increase in sediment from the ground disturbance associated with mechanical treatments (all alternatives) in combination with the activities listed above. The incremental sediment contribution from mechanical treatment under any alternative would be localized and small due to the small size of the disturbed areas.

Under alternatives 4, 3, and 1, the cumulative impact of less effective invasive species treatment would be an increase sediments and nutrients into streams as a result of less effective ground cover and increased fire frequency. In turn, this could impact aquatic organisms and their habitat when combined with the potential sediment increases and changes to stream morphology from the activities listed above. Alternative 4 would have the greatest cumulative impact because it has fewer treatment options and would treat fewer acres.

Forest Plan Consistency

Under the four alternatives, the invasive plant treatments are consistent with forest and grassland plan direction for soil and aquatic resources, including threatened, endangered, and sensitive aquatic species, because they include the resource protection measures described in appendix A.

Issue #4 Human Health

In response to concerns expressed during the comment period for the DEIS, this section has been updated. It includes additional discussion about potential risks to chemically sensitive subgroups. Errors in the acute exposure scenario for glyphosate were corrected (see Table 23 and the discussion following it). Errors in the dosage units for acute exposure were also corrected.

Regulatory Framework

The direction, policies, and requirements listed and discussed below apply to those herbicides currently in use or proposed for use in this project. The term *pesticide* is an all-inclusive term that means "killer of pests" and includes herbicides used for vegetation (FSH 2109.14(12)).

Safety standards for herbicide use are set by the Environmental Protection Agency (EPA), Occupational Health and Safety Administration, Code of Federal Regulations (40 CFR part 170), and individual states. In addition, several sections of the Forest Service manual (FSM 2150, 1994) and the Forest Service handbook (FSH 2109.14) provide guidance for the safe handling and application of herbicides. These include the following:

- Forest Service Health and Safety Code Handbook (FSH) 6709.11 and Forest Service Manual (FSM) 2156 set forth requirements for consultation of pesticide handling (these references are on file in the project record).
- FSH 2109.14 - Pesticide-Use Management and Coordination Handbook (on file in the project record) directs the planning of all pesticide-use management and coordination:

  Chapter 10, section 13.2 lists human health and safety as one of the components to be analyzed in environmental assessments for pesticide use.

  Section 14.3 discusses preparation of project work plans with descriptions of required personal protective clothing and equipment.

  Section 16 describes development of a safety plan to protect the public and employees from unsafe work conditions when pesticides are involved (FSM 2153.3).

Section 16.2 lists the completion of a job hazard analysis (form FS-6700-7) in addition to the safety plan. Job hazard analysis (JHA) is defined in FSH 6709.11. JHAs include requirements for personal protective equipment/clothing, training, qualifications and safety practices.

Section 16.3 discusses the use of pesticide risk assessments as another method to ensure safe pesticide use. A pesticide risk assessment is used to quantitatively evaluate the probability that a given pesticide use might harm humans or other species in the environment. Risk assessments used for this project are discussed in the *Analysis Method* section below.

Analysis Method

The indicators for assessing effects to human health are **potential for exposure, including exposure from spray drift** and **doses in excess of safe reference doses**. For this analysis, the human health risks from the use of herbicides are based on human health and ecological risk assessments conducted by Syracuse Environmental Research Associates (SERA) and on EPA's risk assessments for herbicides. Risk assessment methodology is well documented and generally accepted by the scientific community. The SERA risk assessments are incorporated into this analysis by reference and can be found at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml and in the project file.

There are advantages and disadvantages to the risk assessment process when it is applied to natural resources. Advantages include providing quantitative bases for comparing and prioritizing risks of alternatives and providing decision-makers and the public with an estimate of the risk of adverse effects under typical and extreme scenarios. Disadvantages include a high degree of uncertainty in interpreting and extrapolating data. There is little to no data available on effects of herbicides on humans. Risks to human health are extrapolated from studies done on laboratory animals.

For this analysis, another limitation of the risk assessments is the method used to estimate exposure from aerial spraying. SERA's exposure estimates for aerial application are higher than those found in field conditions because of the calculations used. Another limitation is SERA's modeling of the aerial application of imazapic using only helicopters. Under the preferred alternative, fixed-wing aircraft may also be used to aerially apply imazapic. For the purposes of this analysis, we assume the risk to herbicide mixers/loaders and pilots is the same for helicopters and fixed-wing aircraft. The pilot in the helicopter or fixed-wing aircraft is not exposed because the spraying apparatus is mounted on a boom attached below the enclosed cockpit.

Potential for exposure was assessed based on who would, or might, be exposed and how the exposure could happen. Potential for exposure was evaluated for the general public and for workers applying the herbicides. It was also evaluated by application method: backpack, ground-based, or aerial. Potential for exposure is only part of the assessment of health risk. Another part is comparing the estimated amount of herbicide received from an exposure scenario with a reference dose (RfD) which is a dose the EPA estimates to be without an appreciable risk of adverse effects over a lifetime of daily exposure. Doses less than the RfD are not likely to be associated with adverse health risks. Adverse effects become more likely when exposure exceeds the RfD in frequency or magnitude or both (EPA 1993).[4] RfDs are discussed in detail in the SERA risk assessments.

[4] http://www.epa.gov/iris/rfd.htm

Affected Environment

For human health, the description of existing conditions is restricted to herbicide use. No attempt was made to list all possible environmental factors or outdoor activities that could affect the health of individuals or groups that might be using the forest.

To define baseline or existing conditions for human health, against which the effects of the alternatives will be compared, we evaluated the current level of herbicide application on the forest. This provides a starting point for estimating how alternatives would change potential exposure to herbicides and potential for doses exceeding RfDs. This existing condition is the description of alternative 1 – no action, no change from current management.

The forest treats approximately 2,000-3,000 acres annually. Many of these acres are re-treatment acres, since some infestations require repeated treatment for 5 to 8 years to ensure effective control or provide containment. Treatment includes manual, mechanical, biological, cultural, and chemical (herbicide) means. Herbicides are applied with ground-based methods using backpack-mounted sprayers and vehicle-mounted sprayers. Backpack- and vehicle-mounted systems utilize handheld sprayers; vehicle-mounted systems can also have boom sprayers.

Seventeen herbicides are available for routine weed control (see Table 22). The following eleven are currently being used on the forest: chlorsulfuron, clopyralid, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr and 2,4-D. Six of the seventeen are not currently being used: atrazine, bromacil, diuron, mefluidide, simazine, and tebuthiuron. Herbicides are applied according to label instructions, and the person applying the herbicide is required to wear the appropriate personal protective equipment (PPE).

Environmental Effects

The herbicides used for invasive plant control may affect human health. Alternatives 1, 2, and 3 contain protection measures to minimize health risks to workers and the public. Risk assessments have been prepared for all the herbicides proposed for use. The process of risk assessment is used to quantitatively evaluate the probability (i.e., risk) that an herbicide might pose harm to humans. The complete SERA risk assessments (2003-2011) in the project record contain information about herbicide toxicity, exposure, dose-response relationships, and risk characterization for workers and the general public.

The forest also uses manual and mechanical treatments to control invasive species. No significant human health effects are anticipated from manual or mechanical removal of weeds because required PPE (gloves, long- sleeved shirts, long pants, boots and safety glasses) and proper washing of contaminated PPE would prevent injuries or irritation.

This effects analysis assessed the **potential for exposure, including exposure from spray drift** and the **potential for doses in excess of EPA's reference doses (RfDs).** As mentioned in the *Analysis Method* section, no attempt was made to categorize all the possible effects to human health that exist on the forest.

Table 22. Comparison of herbicides available for use by alternative. Herbicides in italics are not currently in use.

Alternative 1	Alternatives 2 and 3	Alternative 4
	Aminopyralid	No herbicide use
Chlorsulfuron	Chlorsulfuron	
Clopyralid	Clopyralid	
Dicamba	Dicamba	
	Fluroxypyr	
Glyphosate	Glyphosate	
Hexazinone	Hexazinone	
	Imazapic	
Imazapyr	Imazapyr	
Metsulfuron methyl	Metsulfuron methyl	
Picloram	Picloram	
Sulfometuron methyl	Sulfometuron methyl	
Triclopyr	Triclopyr	
2,4-D	2,4-D	
Atrazine		
Bromacil		
Diuron		
Mefluidide		
Simazine		
Tebuthiuron		

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

There would be no negative effects to human health under alternative 4 because herbicides would not be used. Only mechanical, cultural, and biological methods would be used to treat invasive species.

Effects Common to Alternatives 1, 2, and 3

Herbicides would be used in alternatives 1, 2, and 3, and all three include the use of backpack- and vehicle-mounted sprayers. Health risks from herbicide use depend on the toxic properties of the herbicide and the level and duration of exposure.

There is potential for exposure from spray drift with either ground-based or aerial application methods. Aerial herbicide application has a greater potential because the herbicide is released from a greater height. Herbicide labels describe conditions in which spraying – ground or aerial – should not be done.

Spray drift is largely a function of droplet particle size. The largest particles, being the heaviest, will fall to the ground quickly upon exiting the sprayer. Medium size particles can be carried beyond the sprayer swath (the fan shape spray under a nozzle), but virtually all of the particles fall within a short distance of the release point. A small percentage of the spray droplets are small enough to be carried in wind currents to varying distances beyond the point of release. Since these smallest droplets are a minor proportion of the total spray volume, their toxicological significance beyond the project area boundary rapidly declines as they are diluted in increasing volumes of air (Felsot 2001).

Protection measures to reduce exposure: Protection measures designed into these three alternatives would reduce the potential for exposure, including exposure from spray drift and the potential for doses in excess of the EPA's reference doses. Appendix A lists protection measures to reduce and monitor spray drift and to reduce exposure from ground-based or aerial herbicide application.

All herbicides would be applied according to label instructions to minimize exposure and adverse health effects. Label instructions include cautions about breathing and skin or eye contact with the herbicide, requirements for PPE, and recommendations for washing hands and contaminated clothing. PPE generally means gloves, waterproof boots, long sleeved shirts and pants, though the herbicide labels list the PPE requirements for each herbicide. Following label instructions and using PPE would reduce exposure on sensitive areas of the body and protect worker health.

Label instructions for herbicides also include provisions for managing drift, including controlling droplet size and not spraying in the following conditions – high or gusty winds, high temperatures, low humidity, and temperature inversions.

Any time herbicide use is proposed, there is a risk of indirect effects from accidental spills and concerns with storage, transport, and disposal. The SERA risk assessments account for these indirect effects in their potential exposure scenarios. Alternatives 1, 2, and 3 all have the potential for these indirect effects; however, the risk is slightly higher under alternative 2 because more acres are proposed for treatment so more herbicide would be used. Direction outlined in Forest Service Handbook 2109.12 Pesticide Storage, Transportation, Spills and Disposal would be followed for all three alternatives.

Alternative 1 (Current Management) – Direct and Indirect Effects

Alternative 1 includes the use of herbicides but does not allow the use of newly formulated herbicides or those that were not listed in the 1996 EA. Potential exposure and potential for doses exceeding RfDs would be limited to the herbicides currently in use as listed in Table 22. Effects to human health from chlorsulfuron, clopyralid, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr, and 2,4-D are discussed below in the section titled *Effects Common to Alternatives 2 and 3*. A more comprehensive risk discussion for each herbicide is available in the SERA risk assessments which can be found in the project file and at http://www.fs.fed.us/foresthealth/pesticide/risk.shtml.

This alternative includes six herbicides that do not have SERA risk assessments. They are not currently being used on the forest.

Effects Common to Alternatives 2 and 3

The herbicides proposed for use in alternatives 2 and 3 are the same (see Table 23 below). The difference between the two alternatives is the option for aerial spraying under alternative 2.

The adaptive management strategies available under alternatives 2 and 3 would result in fewer risks to human health than under alternative 1. New technology, biological controls, and herbicides are likely to be developed within the life of this project. Under both alternative 2 and 3, these new treatments would be considered if they are more species-specific than methods currently used (alternative 1), less toxic to non-target vegetation and other organisms, less persistent and less mobile in the soil, or more effective.

Under alternative 2, aerial spraying would be used initially to treat cheatgrass with imazapic. In the future, aerial spraying may be used to treat cheatgrass with more effective and/or safer herbicides or to treat other invasive species with herbicides other than imazapic. The adaptive management strategy for selecting the most appropriate and effective control method is described in chapter 2 of the EIS in table 3 and shown in figure 2.

Alternative 2 would pose less risk to workers than alternatives 3 and 1 because it offers the option of aerial spraying which reduces exposure to the herbicide. The person who mixes and loads the herbicide has less contact time with the herbicide, and the pilot who applies it is protected by the enclosed cockpit of the helicopter or fixed-wing aircraft.

The aerial spraying option under alternative 2 could expose the public to drift from spraying; however, this potential exposure would be reduced by following the herbicide label instructions and implementing the protection measures in appendix A. Herbicide labels describe conditions in which spraying – ground or aerial – should not be done, and appendix A of the FEIS lists the protection measures for aerial herbicide application under alternative 2, including use of buffer zones and drift reduction agents and application restrictions for particular weather conditions.

Because aerial herbicide application is more efficient than backpack or vehicle spraying for control of cheatgrass (Haas 2011), alternative 2 could reduce the number of treatments and thus the likelihood of exposure over the long-term. It is estimated that a helicopter can spray about 200 acres per day (50 acres/hour x 4 hours of flight time). A person can hand treat about 2 acres per day under optimal conditions. At this application rate, multiple treatments would be necessary.

According to the SERA risk assessments (2004-2011), herbicide applicators (workers) using ground-based methods are at a higher risk than the general public from herbicide use because they receive repeated exposures that may remain on the skin for an extended period.

The following table summarizes the risks to workers and the general public. The risks are based on projected exposure and EPA's RfDs reported in the SERA risk assessments. Five of the herbicides have estimated chronic[5] and acute[6] exposures less than the RfDs which means there is little risk to workers or the public from exposure. The remaining herbicides exceed the RfDs for chronic or acute exposure for the public or workers or both. In particular, workers applying hexazinone, triclopyr, or 2,4-D could be exposed to doses in excess of the RfDs, making the requirements for PPE and proper handling of contaminated PPE particularly important. A reference dose (RfD) is a dose the EPA estimates to be without an appreciable risk of adverse effects over a lifetime of daily exposure. On the MBRTB, the maximum a worker could conceivably apply herbicides would be 100 days in a given year over a career of 20 years, which is considerably less than a lifetime of daily exposure.

The values in table 23 for workers and the public are the highest estimated chronic and acute exposures for each herbicide (taken from the SERA risk assessments). For the public, acute exposure scenarios include direct spray, dermal contact with contaminated vegetation, and consumption of contaminated fruit, water, and fish. Chronic exposure scenarios for the public also include consumption of contaminated fruit, water, and fish but over a longer period. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility (SERA 2004).

For the herbicides in the following table, when the maximum estimated exposure is less than the RfD, adverse human health effects are not likely. Herbicides where an estimated exposure is greater than the RfD are indicated in boldface type with additional discussion following the table. It is important to note

[5] The term *chronic* refers to longer term exposure; for example, exposure that occurs with multiple herbicide applications over time.
[6] In *acute* exposures, the dose is delivered in a single event, and absorption is rapid. In the SERA risk assessments, the acute exposure scenarios are primarily accidental.

that these figures depict estimated herbicide exposure according to SERA's exposure scenarios; they do not depict the exposure expected under alternatives 2 and 3. With all resource protection measures in place, the exposure from alternatives 2 and 3 is expected to be low.

Table 23. Comparison of risks to workers and the general public from herbicides available under alternatives 1, 2, and 3.

	Reference Dose (RfD)	**Range of Estimated Exposures – chronic (mg/kg/day) and acute (mg/kg)**	
Herbicide	**Chronic RfD mg/kg/day Acute RfD mg/kg**	**Workers**	**General Public**
Aminopyralid	0.5	0.012	0.027
	1.0	0.003	0.4
Imazapyr	2.5	0.07	0.04
	2.5	0.07 or less	0.9
Metsulfuron methyl	0.25	0.0045	0.0024
	0.25	0.0045 or less	0.034
Sulfometuron methyl	0.24	0.007	0.0016
	0.87	0.007 or less	0.094
Chlorsulfuron	0.02	0.0045	0.004
	0.25	0.0045 or less	0.09
Clopyralid	0.15	0.05	**0.2**
	0.75	0.05 or less	**1.8**
Dicamba	0.045	0.007	0.008
	0.10	0.007 or less	**1.0**
Fluroxypyr	1.0	0.08	0.065
	1.0 [7]	0.005	**1.0**
Glyphosate	2.0	0.3	0.08
	2.0	0.01	$1x10^{-10}$ to **2.0**
Hexazinone	0.05	**0.16 to 0.3**	0.006 to **0.16**
	4.0	0.23 to 0.33	**4**
Imazapic	0.5	0.008	0.004
	0.5	0.008 or less	**0.5**
Picloram	0.2	0.05	0.07
	None developed	0.05 or less	**0.7**
Triclopyr	0.05	**0.15**	0.02
	1.0	**4.3**	**5.7**
2,4-D	0.005	**0.15**	**0.2**
	0.025	**0.15 or less**	**2**

Source: SERA 2003-2009

[7] EPA has not developed an acute RfD for fluroxypyr. Acute exposure scenarios in the current Forest Service risk assessment are based on the chronic RfD.

Clopyralid: Under normal conditions, members of the general public would not be exposed to substantial levels of clopyralid. The 0.2 mg/kg/day chronic exposure estimate assumes that an adult (70 kg male) consumes contaminated ambient water from a contaminated pond for a lifetime. The acute exposure estimate of 1.8 mg/kg is associated with the consumption of contaminated water by a child following an accidental spill of clopyralid into a small pond (SERA 2004a).

Dicamba: The acute exposure estimate of 1.0 mg/kg is associated with consumption of contaminated water by a child following an accidental spill of dicamba into a small pond. Direct spray of a child yields an acute exposure estimate of approximately 0.17 mg/kg. Other acute exposures are lower by about an order of magnitude (SERA 2004b).

Potter and others (1993) found increased incidences of acetylcholinesterase inhibition in farm workers who were repeatedly exposed to dicamba (SERA 2004b). Acetylcholine is a neurotransmitter (a chemical released from a nerve cell) that helps with memory and thinking.[8] It is also essential for communication between the nerves and muscles. An acetylcholinesterase inhibitor is a chemical that inhibits the acetylcholinesterase enzyme from breaking down acetylcholine. Common side effects of acetylcholinesterase inhibition include diarrhea, headache, nausea, vomiting, and insomnia.[9]

Fluroxypyr: The acute exposure estimate of 1 mg/kg is associated with the consumption of contaminated fish by subsistence populations shortly after an accidental spill. This exposure scenario is highly arbitrary. A more plausible, but still extreme, exposure scenario is about 0.6 mg/kg; this is associated with the consumption of contaminated vegetation. The other acute exposure scenarios lead to much lower dose estimates (SERA 2009).

Glyphosate: The acute exposure scenario assumes a young child consumes contaminated water from a small pond after an accidental spill. The amount of field solution of glyphosate spilled was assumed to be 100 gallons. This exposure scenario is based on assumptions that are somewhat arbitrary and highly variable, so it may overestimate exposure. A more plausible, but still extreme, scenario is consumption of contaminated vegetation which results in a dose of 1.4 mg/kg (SERA 2011a).

Hexazinone: Unless workers follow prudent handling practices to minimize exposure, the chronic RfD is likely to be exceeded. For the public, the chronic exposure estimate range is associated with the longer-term consumption of contaminated vegetation. The difference in estimates is for granular versus liquid formulations and relates to well-documented differences in the deposition of hexazinone on vegetation between the two. The acute exposure estimate of 4 mg/kg is associated with an accidental spill into a small pond. This is a highly arbitrary exposure scenario. (SERA 2005).

Imazapic: The acute estimated exposure of 0.5 mg/kg is associated with the consumption of contaminated water by a child following an accidental spill of imazapic into a small pond. Direct spray of a child yields an acute exposure estimate of 0.145 mg/kg. Other acute exposures are lower by about an order of magnitude (SERA 2004c).

Picloram: The acute estimated exposure of 0.7 mg/kg is associated with the consumption of contaminated water by a child following an accidental spill of picloram into a small pond. The highest dose estimates (0.07 mg/kg) for non-accidental exposure scenarios are associated with the consumption of contaminated vegetation or fish. Exposures from dermal contact or drinking contaminated water are likely to be much lower (SERA 2011b).

[8] Source: http://www.webmd.com/alzheimers/cholinesterase-inhibitors-for-alzheimers-disease
[9] Source: http://en.wikipedia.org/wiki/Acetylcholinesterase_inhibitor

Triclopyr: For workers, the estimated chronic dose of 0.15 mg/kg/day is for broadcast ground spraying. The estimated acute dose of 4.3 mg/kg is for accidental exposure with the worker wearing contaminated gloves for 1 hour. For workers who may apply triclopyr repeatedly over a period of several weeks or longer, work practices should include procedures to avoid the upper extremes of potential exposure. At higher application rates, particularly those approaching 10 lbs/acre, measures should be taken to limit exposure. For the public, the estimated acute dose of 5.7 mg/kg is for accidental direct spray of the entire body of a naked child. The scenario assumes that 100% of the surface area of the body is exposed (SERA 2011c).

2,4-D: For workers, many chronic exposure scenarios exceed the level of concern and often by a very substantial margin. Workers involved in the application of 2,4-D could be exposed to levels greater than those generally regarded as acceptable. Aggressive measures are warranted to provide workers with adequate protective clothing and to keep the protective clothing free of gross contamination (SERA 2006).

For the public, the chronic exposure estimate of 0.2 mg/kg/day is associated with longer-term consumption of contaminated vegetation. The acute exposure estimate of 2 mg/kg is associated with a child’s consumption of contaminated water from an accidental spill. This exposure scenario is highly arbitrary. Other acute exposure scenarios lead to much lower dose estimates – 0.2 mg/kg or less (SERA 2006). However, these still exceed the RfD.

Sensitive Subgroups

In response to concerns expressed during the comment period for the DEIS, this section has been updated. It includes a list of protection measures (from appendix A) and additional discussion about the potential risks to chemically sensitive subgroups.

Despite the limited risk of adverse health effects predicted based on EPA testing, label restrictions, and the risk assessments, people who are hypersensitive to chemicals in the environment may be inadvertently exposed to, and adversely affected by, herbicide residues if they use the localized sites where an herbicide has been applied.

FEIS appendix A contains the following protection measures to address this human health risk. Posting signs in an area to be treated allows people to determine when to enter such an area. Each product label contains the re-entry interval for agricultural workers and non-agricultural workers specific to the chemical.

General protection measures

- Provide a minimum buffer of 300 feet for aerial application of herbicides from developed campgrounds, recreation residences, and private residential areas (unless otherwise authorized by adjacent private landowners). Treat outside of high use periods where feasible. Temporary closures of campgrounds may be considered to ensure public safety during spray operations.
- Signing (see below) and on-site layout would be performed one to two weeks prior to actual aerial treatment.
- Temporary area and road/trail closures would be used to ensure public safety during aerial spray operations.

Measures to reduce spray drift

- Application will occur only when wind speeds are less than 6 mph (or per label instruction). Spray drift is largely a function of droplet particle size, release height, air temperature and wind speed. Incorporate these factors into project design to reduce the risk of drift.
- Application will only occur when wind conditions are favorable; i.e., when the wind is blowing into the treatment area and away from sensitive areas.
- Aerial spray units would be field-validated, flagged, and/or marked using GPS prior to spraying to ensure only appropriate portions of the unit are aerially treated. To ensure that aerial treatments stay within intended treatment areas, units will be GPSed before and during the flight.
- A field inspector will be present during all aerial application to monitor drift using spray detection cards placed in buffer areas. Cards will be placed prior to herbicide application and will be sufficient in number and distribution to adequately determine when drift of herbicide into the buffer area exceeds acceptable levels. Non-toxic dye would be added to make herbicide visible on spray cards. Dye would allow observers to see herbicide as it is sprayed and to visually monitor drift or vortices from boom and rotor tips.
- Drift reduction agents, nozzles that create large droplets, and special boom and nozzle placement, would be used to reduce drift during aerial spraying.
- Drift control agents may be used in aerial spraying during low humidity to reduce drift into non-target areas. Products that reduce volatility, keep droplet sizes larger, and are the appropriate adjuvant for the herbicide (as specified by labeling of both the herbicide and the drift agent, in consultation with the herbicide manufacturer) would be used.
- Aerial spraying will be discontinued if herbicide is drifting within the set-back zone and/or wind speed exceeds those recommended on the product's label.
- Weather conditions would be monitored on-site (temperature, humidity, wind speed and direction), and spot forecasts would be reviewed for adverse weather conditions.
- Maintain boom pressure at less than 40 psi and use nozzles designed for medium to coarse droplet size (240 to 400 microns). Use a drift agent to help maintain large droplet size.
- Monitor treatment boundaries next to sensitive areas with spray deposit cards to detect any possible drift. Train people in how to handle the cards, interpret the cards (many things can contaminate the cards such as dew, moisture from hands, insects) and also document results. Card lines should also be placed in treated areas under full spray to serve as a reference.

Potential effects to sensitive subgroups by herbicide

Aminopyralid: The SERA risk assessment did not identify any information to suggest that specific groups or individuals would be especially sensitive to systemic effects of aminopyralid; however, data in humans is lacking making it impossible to identify critical effects. In studies on animals, aminopyralid did not appear to have any remarkable systemic toxic effects. Ocular effects (lacrimation and cloudy eyes) were noted in one study with rats, and lack of coordination was noted in three developmental studies in rabbits. Both of these effects were noted after gavage[10] exposure which has limited relevance to human exposure from invasive plant treatments. Remarkable effects in lymphoid tissue have not been noted in standard toxicity studies on aminopyralid. Changes in lymphoid tissue and blood can indicate suppression or stimulation of the immune system (SERA 2007).

[10] Gavage - introduction of material into the stomach by a tube.

2,4-D: Sunscreens increase the dermal permeability of 2,4-D, so individuals who are wearing sunscreen and exposed to 2,4-D may absorb more of the compound and have adverse dermal effects. 2,4-D is capable of adversely affecting the immune system. Accordingly, individuals who are immuno-compromised may be unusually sensitive to 2,4-D. 2,4-D disrupts cells at the level of the membrane and basic metabolic function. Individuals with diseases that compromise cell integrity (e.g., sickle cell anemia) may be more sensitive to exposure (SERA 2006).

Chlorsulfuron: The SERA risk assessment did not identify any information to suggest specific groups or individuals would be especially sensitive to systemic effects of chlorsulfuron; however, data in humans is lacking. In subchronic and chronic exposure studies, weight loss and decreased weight gain were observed in rats and rabbits. There some evidence that chlorsulfuron may cause changes in the blood or in blood producing organs. Some sulfonurea herbicides (of which chlorsulfuron is one) may affect blood cholesterol and serum triglycerides and alter hematological parameters; some reduce blood glucose or reduce the extraction of insulin. However, it is unclear if individuals with pre-existing diseases of the hematological system[11] or metabolic disorders would be particularly sensitive to chlorsulfuron exposure (SERA 2004d).

Clopyralid: The SERA risk assessment did not identify any information to suggest specific groups or individuals would be especially sensitive to systemic effects of clopyralid. At doses of 100 mg/kg/day, effects observed in laboratory animals included weight loss, changes in liver and kidney weight, thickening of epithelial tissue lining the stomach, irritation of the lungs, and decreases in red blood cell counts. The observed effects varied among different animal species tested and also between studies of the same species, so it is not clear whether individuals with pre-existing kidney, liver, or blood diseases would be more sensitive to clopyralid exposure (SERA 2004a).

Dicamba: The only identified sensitive subgroup for dicamba appears to be children. EPA's RfD for chronic exposure includes an additional uncertainty factor to address exposures involving children (SERA 2004b). Since the RfD considers children's increased sensitivity and since SERA's risk assessment evaluated effects to children as described in the previous section, they were not analyzed as a separate subgroup.

Fluroxypyr: The SERA risk assessment did not identify any reports that associated fluroxypyr exposure with adverse effects in individuals who report having multiple chemical sensitivity. In experimental mammals, kidney damage and general weight loss are the most common effects associated with high levels of exposure to fluroxypyr. Fluroxypyr is absorbed and excreted rapidly. The mechanism of excretion involves active uptake by, and concentration in, the kidneys; thus, individuals with kidney diseases might be more sensitive to fluroxypyr (SERA 2009).

Glyphosate: The most sensitive subgroup for exposure to glyphosate and glyphosate formulations appears to be pregnant women and the developing fetus. Animal studies by Roxwell (1980) and Moxon (1996) indicate that hazard quotients (HQs) greater than 5.6 and 5, respectively, could raise health concerns for pregnant women. In the SERA risk assessment, none of the calculated HQs exceeded a level of concern at an application rate of 1 lb a.e./acre. The highest HQ was calculated for consumption of contaminated water after an accidental spill. In this scenario, the HQ reached the level of concern – HQ = 1 – but did not exceed it (SERA 2011a).

[11] The hematologic system is made up of the blood, spleen, bone marrow, and liver.

Hexazinone: The most sensitive subgroup for exposure to hexazinone appears to be pregnant women and the developing fetus. Mullin (1987) observed kidney malformations and delayed bone development in rat offspring when the mothers received doses of 900 mg/kg/day. Serota and others (1980) observed only delayed bone development in rabbit offspring when the mothers received doses of 125 mg/kg/day. At both the 900 and 125 mg/kg/day doses, there were signs of maternal toxicity (SERA 2005).

Imazapic: The SERA risk assessment did not identify any information to suggest specific groups or individuals would be especially sensitive to systemic effects of imazapic; however, data in humans is lacking. Based on four unpublished animal studies (Fischer 1992 and 1994, Wolford 1993), imazapic does not appear to be toxic to rodents at relatively high concentrations in the diet (except in pregnant rabbits) but is toxic to dogs. Wolford (1993) noted adverse effects to blood and bone marrow, muscular degeneration, and markers for liver toxicity in dogs receiving the highest dose tested – 1,000 mg/kg/day – for the one-year study. At half that dose (500 mg/kg/day), similar but less severe effects were noted. It is unclear if people with pre-existing diseases of the hematological system, muscles, or liver would be particularly sensitive to imazapic exposure. However, individuals with any severe disease condition could be considered more sensitive to many toxic agents (SERA 2004c).

Imazapyr: Given the very low HQs for imazapyr, there appears to be no basis for asserting that adverse effects in a specific subgroup are plausible. U.S. EPA (2005a) judges that infants and children are not likely to be more sensitive than adults to imazapyr. In chronic and subchronic dietary toxicity studies in dogs, mice, and rats, no adverse effects from imazapyr were noted at doses of up to about 2,000 mg/kg/day in rats and mice and about 250 mg/kg/day in dogs. EPA (2005) did not identify concerns about neurotoxicity nor is there any basis for concern about imazapyr's effects on the immune system based on the lack of adverse results in the subchronic and chronic toxicity studies. None of the animal studies reports abnormal thyroid cells, tissue, or hormone levels which could indicate adverse effects to the endocrine system (SERA 2011d).

Metsulfuron methyl: The SERA risk assessment did not identify any information to suggest that specific groups or individuals may be especially sensitive to metsulfuron methyl; however, data in humans is lacking. Decreased body weight gain was the most common sign of acute, subchronic, and chronic toxicity in laboratory animals. The four chronic studies (Burns 1984, Burdock and Hamada 1985, Stadler 1984, Burdock 1984) reported decreased body weight in rats, mice, and dogs. Decreased body weight and/or growth rate were reported in all the subchronic studies of rats (Brock 1985; Burdock et al. 1982; Daly 1985; Pastoor 1985; Wiechman et al. 1982). At one month and three months, Brock also noted lower serum glucose and higher serum cholesterol in female rats. If exposure levels were sufficient to cause decreases in serum glucose, people taking medication to lower serum glucose could be at increased risk; however, this exposure scenario is highly implausible (SERA 2004e).

Picloram: The SERA risk assessment did not identify any information to suggest that specific groups or individuals may be especially sensitive to picloram; however, data on humans is lacking. In two metabolism studies in rats (Nolan et al. 1980, Reitz et al. 1989), picloram was rapidly absorbed following oral administration and rapidly excreted following i.v. or oral administration; most of the dose was recovered as unmetabolized picloram in the urine. Similar rapid absorption and excretion results were obtained in Nolan's 1984 study of six human volunteers. In chronic and subchronic studies on rats, the most common effects noted were increases in organ weight and an acceleration of normal kidney and liver lesions. Individuals with kidney disease could have an impaired ability to excrete picloram, as well as many other weak acids; however, the SERA risk assessment did not identify any reports linking adverse effects in individuals with kidney disease with picloram exposures (SERA 2011b).

Sulfometuron methyl: The SERA risk assessment did not identify any information to suggest that specific groups or individuals may be especially sensitive to sulfometuron methyl; however, data on humans is lacking. In rats, the most sensitive effects reported for chronic sulfometuron methyl exposure were decreased body weight gain (Hoberman et al. 1981) and changes in blood consistent with hemolytic anemia (anemia caused by high rates of red blood cell destruction) (Wood and O'Neal 1983, Summers 1990a, Wood et al. 1980, Mullin 1984). Thus, individuals with pre-existing anemia could potentially be at an increased risk (SERA 2004f).

People with pre-existing thyroid dysfunction may be at risk; however, SERA risk assessment did not find data to support this speculation. Sulfometuron methyl may alter thyroid gland function. Nishikawa (1983a, b) observed dose-related changes in the thyroid gland and in thyroid hormone (T3 and T4) levels in rats when they were given 2,000 mg/kg sulfonamide over a 15-day period (sulfonamide is a metabolite of sulfometuron methyl). Wood and others (1980) also noted elevated thyroid hormone levels in female rats dosed with dietary sulfometuron methyl (100 and 1,000 ppm) for 90 days (SERA 2004f).

Triclopyr: While there are no epidemiology studies supporting a link between exposure to triclopyr and adverse reproductive outcomes in humans, reproductive toxicity is a concern in Forest Service risk assessments. In rats and rabbits, triclopyr is associated with adverse reproductive effects, including birth defects. These effects occur at doses that are toxic to the mothers. In their two-generation reproduction study of rats, Vedula and others (1995) observed adverse effects to both parents and offspring at doses of 250 mg/kg/day. Adult rats exhibited decreased food consumption and body weights and tissue changes in the liver and kidneys. Adverse effects also included decreased offspring weights, survival, and litter sizes. (SERA 2011c)

Individuals with kidney disease could have an impaired ability to excrete triclopyr. Triclopyr is excreted primarily by the kidney. Barna-Lloyd and others (1992) noted kidney tissue changes and higher relative kidney weights in male rats at doses of 70 mg/kg/day; the effects were not present in the female rats. At doses of 350 mg/kg/day, both male and female rats exhibited lower body weights and feed consumption, higher relative kidney weights, and degeneration or regeneration of the descending portion of the kidney proximal tubules[12] (SERA 2011c).

Cumulative Effects – All Alternatives

There would be no cumulative effects from alternative 4 because herbicides would not be used to treat invasive plants.

Herbicide Treatments

The analysis area for cumulative effects on human health is the area in and immediately adjacent to the Medicine Bow-Routt National Forest and Thunder Basin National Grassland. The temporal boundary is 15 years, the expected length of this project. As noted previously, no attempt was made to categorize all the potential impacts to human health that could occur on the national forest/grassland. Therefore, the cumulative effects analysis considered past, present, and reasonably foreseeable future aerial and ground application of herbicides on private and public lands in Colorado and Wyoming, including herbicide spraying along the highway rights-of-way by the Colorado and Wyoming departments of transportation.

For the general public and for herbicide applicators, there would be no cumulative effects from herbicide treatments under alternatives 1, 2, or 3 because there would be no exposure overlap in time (i.e., a person would not be exposed to multiple herbicide applications in the same 24- to 48-hour period).

Most invasive plant treatments on the MBRTB are done cooperatively across ownership boundaries. As noted in chapter 1 of the EIS, the forest has weed management agreements with the counties, the Rocky

[12] The proximal tubule is the portion of the duct system of the nephron of the kidney.

Mountain Elk Foundation, and Western Area Power Association. In these agreements, areas to be treated are mapped or the physical location is described, and one entity is responsible for treatment of the infestation which means there is no treatment or exposure overlap in time.

Where there are no cooperative weed agreements, the likelihood of timing overlap is remote because our treatment areas would be posted so the public could avoid them and our workers would not enter and treat an area if the adjacent area appeared to have been recently treated (leaves are wet, chemical smell, dye present on leaves).

For sensitive subgroups, there could be cumulative effects from alternatives 1, 2, and 3 if individuals who are sensitive to chemicals are exposed to herbicides on the MBRTB and on adjacent county, state, or private land also being treated with herbicides. The potential cumulative effects would be greater under alternative 2 because of the larger treatment areas possible with aerial spraying. The effects would be reduced by implementing the protection measures for aerial spraying listed in appendix A.

A comment on the DEIS (received May 2, 2014) identified individuals (the Smiths) with multiple chemical sensitivities. The individuals own property (T14N, R77W, sections 7 and 18) that abuts the forest boundary. The cumulative effects of this project combined with effects from herbicide use along County Road 47 and WY 11 could adversely impact the health of the Smiths if they came in contact with herbicides on the forest and along County Road 47 or WY 11. The effects are impossible to predict without knowing the herbicide(s) encountered. Potential effects by herbicide are discussed in the previous section.

Albany County Weed and Pest treats invasive species along County Road 47 (Fox Creek Road) every other year (pers. comm. with Lindsay Cawthra, June 2014). Part of County Road 47 is near the northern and eastern boundaries of the Smith's property. The county treats from the junction with WY 11 to WY 230. They also treat the parking and trailhead area for the Forbes/Sheep Mountain wildlife habitat management area for the Wyoming Game and Fish Department (pers. comm. with Lindsay Cawthra, June 2014). It is located just east of County Road 47 in Section 20, approximately 2 miles from the southeast corner of the Smith's property.

The Wyoming Department of Transportation has used herbicides along WY 11 to treat noxious weeds and to control unwanted vegetation impinging on the road shoulder and around delineator posts (pers. comm. with Joe Gillespie, June 2014). Part of WY 11 is near the northwest corner of the Smith's property.

The Cheyenne Board of Public Utilities (BPU) manages the aqueduct that runs through the proposed herbicide exclusion zone. Our agreement with BPU grants them an easement to access and manage the aqueduct. Noxious weed control is a requirement in the easement (pers. comm. with Patricia Hesch, 2014).

Forest Plan Consistency

The Thunder Basin plan contains the following guideline that prescribes direction for human health and safety. The four alternatives are consistent with this direction.

> Control insects and diseases using integrated pest management techniques. Treatment activities will be based on potential risks to human health and the value of and risks to wildlife habitat, adjacent lands, public lands, and other resources. Priority should be given to areas where values to be protected exceed the cost of protection. (Noxious Weeds, Non-native, and Invasive Species guideline 8)

Wilderness, Recommended Wilderness, Eligible Wild and Scenic Rivers

Regulatory Framework

The Wilderness Act of 1964 defined wilderness and established the National Wilderness Preservation System. Wilderness management occurs in accordance with the enabling legislation and Forest Service policy, which regulates human use and influence in order to preserve the quality, character, and integrity of wilderness lands. Recommended wilderness is managed to retain the qualities that make them eligible for wilderness designation. Activities that would be prohibited in designated wilderness, such as motorized use, may be allowed in recommended wilderness areas. Section 4(c) of the Wilderness Act provides the opportunity for invasive plant treatment, including the use of mechanized equipment and herbicides, if such activities are the minimum required to administer a given area as wilderness.

The Wild and Scenic Rivers Act was enacted by Congress to preserve select rivers in a free-flowing condition and to protect other river-related values. The general management approach for eligible rivers is to allow management actions, proposed new uses, or new facilities unless they could cause recommendation against designation. Invasive plants may be of concern for eligible wild and scenic rivers if they threaten scenic or other outstandingly remarkable values.

Analysis Method

The analysis for wilderness evaluated the potential for invasive plant treatment alternatives to affect the untrammeled, natural qualities of, and opportunities for solitude in, wilderness and recommended wilderness. The analysis for wild and scenic rivers evaluated the potential for invasive plant treatment alternatives to affect scenery, recreation, wildlife habitat, or other outstandingly remarkable values that make a given river eligible for designation.

Affected Environment

The MBRTB administers all or part of ten designated wilderness areas. Four areas are located primarily on the Medicine Bow NF, and six are wholly or partially on the Routt NF. There are no designated wilderness areas on the Thunder Basin National Grassland.

Five of the six wilderness areas managed by the MBR have known populations of high priority noxious weeds (leafy spurge, yellow toadflax, and musk thistle, for example), as does the portion of the Flat Tops Wilderness managed by the MBRTB. All seven contain lower-priority weeds as well, such as houndstongue and Canada thistle. There are cheatgrass infestations at lower elevations along access roads and at the trailheads.

There are also three recommended wilderness areas on the Medicine Bow and Routt national forests. They are additions to Huston Park Wilderness (8,083 acres) and the Encampment River Wilderness (2,349 acres), and one new area, Rock Creek (17,530 acres), for a total of 27,963 acres. There are high priority noxious weed species in the Encampment River addition and in Rock Creek. Canada thistle is known to exist in the Huston Park proposed addition.

Table 24. Wilderness areas and acres on the Medicine Bow and Routt national forests.

Forest Unit	Wilderness Name	Acres on MBR
Medicine Bow	Huston Park	30,588
	Platte River	23,492
	Savage Run	14,297
	Encampment River	10,124
Routt	Mount Zirkel	160,648
	Sarvis Creek	47,140
	Flat Tops*	38,870
	Never Summer**	6,659
	Rawah**	1,462
	Neota**	267
	Total Wilderness Acres	**333,547**

*Lead management unit is the White River National Forest
**Lead management unit is the Arapaho-Roosevelt National Forest

Herbicide treatment is approved for the high priority weed species and is a part of the approved wilderness management plan for each of the six affected areas. Some lower priority weeds (e.g., houndstongue) can be effectively controlled by pulling or grubbing, after which the weeds are bagged and hauled out of the wilderness. However, virtually all of the high priority species cannot be controlled in that manner and may even spread with such attempts. For these, herbicide application is the only long-term solution to eliminate them and maintain native plant communities and the wilderness character.

All streams in the MBRTB have been evaluated for wild and scenic eligibility. The following table lists eligible rivers, along with their length, values, and potential classification. Nearly all the eligible wild and scenic rivers (North Platte, Encampment, Red Canyon, Rock, and Little Snake) have known populations of high priority noxious weeds, and all have at least some areas with cheatgrass infestations.

Table 25. Rivers eligible for inclusion into the National Wild and Scenic River system.

River or Segment Name	Length (miles)	Outstandingly Remarkable Values	Potential Classification
Encampment River (Routt)	19.50	F,W	Wild
Encampment River (Medicine Bow)	11.70	S,R,W,F,V	Wild/Scenic
Elk River	29.00	S,R	Wild/Scenic
North Platte River (Medicine Bow)	16.35	S,R,W,F	Wild/Scenic
North Platte River (Routt)	5.00	S,R,F	Wild
North Fork Little Snake	9.36	F	Scenic
W. Branch North Fork Little Snake	7.72	F	Scenic
Lower Rock Creek	5.10	S,G,F,W,P	Wild
Roaring Fork Creek Red Canyon Creek	2.60 2.30	S,G,W	Wild
Roaring Fork Little Snake	3.73	F	Wild
Rose Creek	0.89	F	Scenic

S=scenic, R=recreational, W=wildlife, F=fish, G=geologic, P=prehistoric culture, V=vegetation

Environmental Effects

Alternative 1 – Direct and Indirect Effects

Wilderness and recommended wilderness: Limited hand application and horse/mule-carried herbicide sprayers, as well as hand pulling of invasive plants, would continue. Opportunities for wilderness solitude could be directly, adversely impacted by the presence of people and equipment engaged in treatment activities, but any such impacts would be sporadic and temporary, and thus minor. Treatment activities would impact the untrammeled, natural quality of wilderness, but these adverse impacts would be offset by the beneficial impact to naturalness that occurs when invasive plants are controlled.

This alternative does not treat all invasive plant species and limits the herbicides available for use. As a result, more acres of native plant communities may become infested which could adversely impact naturalness in wilderness and scenic, wildlife, and fisheries values in wilderness and recommended wilderness.

Eligible wild and scenic rivers: Direct effects of the current treatment approach on outstandingly remarkable river values would be negligible. However, because this alternative is less effective at treating invasive plants, more acres of native plant communities may become infested which could adversely impact scenic, wildlife, and fisheries values in eligible river corridors.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

Wilderness and recommended wilderness: Effects of alternative 2 on the untrammeled, natural quality of wilderness would be similar to those described for alternative 1. Beneficial impacts from effective treatment would be greater because newer herbicides would be available for use and aerial treatment is an option. Aerial treatment would only be used in designated wilderness if necessary to protect native plant populations, and it would include a 300-foot buffer to protect streams, lakes, wetlands, and riparian areas.

If aerial application is used to treat cheatgrass, impacts on opportunities for solitude would be greater under the preferred alternative than under alternatives 1, 3, and 4. However, these impacts are still expected to be minimal because most cheatgrass infestations are at lower elevations and most designated and recommended wilderness are at elevations above 9,000 feet.

Eligible wild and scenic rivers: The effects of the preferred alternative on outstandingly remarkable river values would be negligible. The option to use newer, more selective and effective herbicides could reduce the potential adverse effects of invasive species introduction and spread in the river corridors.

Alternative 3 (No Aerial Application) – Direct and Indirect Effects

Wilderness and recommended wilderness: Effects of the alternative 3 on the untrammeled, natural quality of wilderness would be similar to those described for alternative 1. Beneficial impacts on the natural quality of wilderness would be the same as alternative 2 because newer, more selective and effective herbicides would be available for use.

Eligible wild and scenic rivers: The effects of alternative 3 and alternative 2 are the same.

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

Wilderness and recommended wilderness: Adverse impacts on the untrammeled, natural quality of wilderness would be greatest under this alternative because of the limited acres proposed for treatment and the limited effectiveness of the treatment options. Only 500 to 1,200 acres forestwide would be treated annually: 60-75% less than are presently treated each year. Because manual, mechanical, biological, and cultural treatments have limited effectiveness, invasive plant infestations would spread and alter or replace native plant communities in some wilderness areas. Opportunities for wilderness solitude could be directly, adversely impacted by the presence of people engaged in treatment activities, but such impacts would be sporadic and temporary, and thus minor.

Eligible wild and scenic rivers: The adverse effects would be greatest under this alternative. The inability to use herbicides would result in a less effective invasive plant treatment program. In some areas, scenery and wildlife forage would be altered by invasive plants. Fish habitat could also be adversely impacted if invasive plants provide less effective ground cover. Less effective ground cover increases the potential for erosion and sedimentation which can impact water quality.

Cumulative Effects

The temporal boundary for this cumulative effects analysis is 1998 through 2018. This period covers the time from completion of the Routt NF plan (the oldest of the three plans that guide management on the MBRTB) through the farthest target date for completing actions described in the forest and grassland plan(s). The spatial bounds for the analysis are the lands administered by the MBRTB and adjacent forest lands on the Arapaho-Roosevelt and White River national forests that contain wilderness areas co-managed by the MBRTB. The past, present, and reasonably foreseeable future action evaluated was fire suppression. Fire suppression does not affect opportunities for solitude so there are no cumulative effects to that aspect of wilderness and recommended wilderness.

The increase in invasive plant infestations that is likely to occur under alternatives 4 and 1 would add to the unnatural conditions in the project area resulting from fire suppression. Direct suppression of fires in wilderness areas, while relatively uncommon, has occurred during the analysis period. In addition, fires outside of wilderness that would likely have spread into wilderness have been suppressed to protect property and other values. Recent experience from the 2012 fire season suggests that, in drought years, fire personnel may be directed to suppress fires wherever they occur due to the threat of out-of-control burns escaping into communities. The growing human population in wildland-urban interface areas exacerbates this problem.

The cumulative effects of fire suppression and alternative 2 or 3 on the natural and untrammeled characteristics of wilderness and recommended wilderness would be less than the effects from alternatives 4 and 1. Alternatives 2 and 3 allow the use of newer more effective herbicides which could improve treatment efficacy and reduce impacts of invasive species.

Forest Plan Consistency

The treatment activities proposed in the four alternatives are consistent with forest and grassland plan standards and guidelines for wilderness, recommended wilderness, and eligible wild and scenic rivers. There is no wilderness, recommended wilderness, or wild and scenic rivers on the Thunder Basin NG.

Special Interest Areas (SIAs) and Research Natural Areas (RNAs)

SIAs are managed with emphasis on protecting or enhancing areas of unusual characteristics. This includes botanical characteristics such as uncommon plant habitats or rare plant species. RNAs are selected to provide a spectrum of relatively undisturbed areas representing a wide range of natural variability within important natural ecosystems. RNAs are often areas with special or unique characteristics or scientific importance. Some RNAs represent key elements of plant diversity on the MBRTB because they include sites with rare plants and specialized plant habitats.

Affected Environment

No significant issues related to these resources were identified during public scoping. However, the MBRTB identified the potential effects of invasive plant treatment on RNAs and SIAs as a concern.

Of the twenty-five SIAs on the MBRTB, nine have been designated, all or in part, for the protection and enhancement of botanical values. Some support Region 2 sensitive species; others have vegetation communities that are natural and undisturbed or that support important wildlife species.

Invasive weed populations exist in most of the botanical SIAs on the forest. Canada thistle (*Cirsium arvense*) is common in wetland and riparian areas across the forest, and infestations of cheatgrass (*Bromus tectorum)* are present on sections of the Laramie Peak unit and the Thunder Basin National Grassland.

The remaining fifteen SIAs were designated as geological, historical, paleontological, scenic, zoological or a combination of those features. The MBRTB forest and grassland plans include the following desired condition statement for SIAs:

> *Vegetation manipulation may be used to maintain or restore natural conditions; to protect threatened, endangered, and sensitive species; or enhance other values for which the SIA was designated.*

There are ten RNAs on the forest, all of which have varying degrees of botanical importance. The Kettle Lakes RNA is one of the most interesting and botanically valuable RNAs on the MBRTB. It is a forested area in the Mount Zirkel Wilderness dotted with kettle pond wetlands. These ponds and wetlands support diverse botanical communities including some sensitive plants. Effects to sphagnum mosses, round-leaf sundew, and slender cottongrass are discussed in the botany section of this chapter and in the *Biological Assessment and Biological Evaluation of Plant Species* report on file in the project record.

Canada thistle has been found in the Kettle Lakes and Mad Creek RNAs, and the establishment record for each recommends treatment of infestations as soon as possible to prevent expansion. The use of chemical herbicides for invasive species control or eradication is permitted in RNAs as long as the original qualities for which the RNAs were selected are maintained. Most RNAs on the MBRTB do not have an establishment record, which means that invasive species populations have not been officially inventoried, although invasive species populations are known to occur in most of these areas.

Environmental Effects

To protect the values for which the SIAs and RNAs were identified, the measures listed below would be implemented. Appendix A contains a complete list of protection measures, including those that apply to threatened, endangered, and sensitive plant species and riparian/wetland areas.

- If any treatment is desired within RNA boundaries, concurrence must be obtained from the forest botanist, cooperating USFS Research Station, and all other relevant partners prior to treatment implementation.
- If treatment is desired in SIAs that have special values, treatment must be planned and executed with concurrence from the appropriate forest program manager for that value.

The effects analysis focused on those SIAs designated to protect and enhance botanical values since they are most likely to be affected by treatment of invasive plant species. For effects to SIAs with historical components, see the discussion in the *Cultural Resources* section. Zoological effects are covered in the wildlife section. Effects to scenic values would be similar to those discussed above for wilderness and wild and scenic rivers.

Alternative 1 (Current Management) – Direct and Indirect Effects

Hand-pulling of weeds is unlikely to adversely impact the special qualities of SIAs and RNAs, but may be a low-impact method of reducing small-scale weed infestations.

Herbicide use in SIAs and RNAs would be tightly controlled, and herbicides would only be used when deemed necessary by specialists from multiple disciplines and/or outside agencies. This would greatly reduce or prevent possible adverse effects. Chemical treatments should be avoided when possible in other areas with high wetland cover and where sensitive species and wetland/water body buffer zones are difficult to administer.

The beneficial effects of weed control in RNAs and SIAs are potentially great. The ability to treat infestations as they are discovered and before they threaten local vegetation on a large scale may be vital to preserving the natural and undisturbed nature of native vegetation and high-value plant communities. If weed invasions were allowed to occur unchecked, some SIAs and RNAs could experience shifts in vegetation. Changes in species composition and related effects on soils and fire regimes could compromise the utility of SIAs and RNAS for conservation, research, education, and as reference landscapes. Treating weed infestations as they occur is also consistent with the forest plan and specific guidance for established RNAs and some SIAs.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

Alternative 2 includes all of the actions and associated beneficial and adverse effects of alternative 1. Additional treatments proposed in alternative 2 include the use of chemical herbicides and biocontrol mechanisms that are developed in the future and are not yet approved, and the use of aerial spraying to apply selective herbicides. Aerial herbicide application is unlikely to be frequently used in RNAs and SIAs.

Aerial application would be controlled by protection measures and used only when deemed necessary by specialists from multiple disciplines and/or outside agencies. This would greatly reduce or prevent many possible adverse effects. Aerial spraying is not recommended in any SIA or RNA that has high wetland cover or abundant sensitive species because spray buffers may be hard to administer and windy conditions may cause excessive herbicide drift. Aerial spraying is discouraged in the Kettle Lakes RNA which has known and suspected occurrences of sensitive species and abundant kettle pond wetlands, ponds, and fens.

Alternative 3 (No Aerial Application) – Direct and Indirect Effects

The effects of this alternative would be the same as those described for alternative 2 minus the effects of aerial herbicide application.

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

The lack of effective invasive species control under this alternative could have adverse effects on RNAs and SIAs. Not controlling invasive species could lead to significant increases in the abundance, density, or extent of noxious weed or invasive plant populations. This could compromise the utility of the RNAs and SIAs for conservation, research, education, and as reference landscapes.

Cumulative Effects

There are no cumulative effects because we don’t allow any activities in RNAs and SIAs that could jeopardize the reasons for which they were designated so we don’t have any past, present, or reasonably foreseeable future actions affecting these areas.

Forest Plan Consistency

The four alternatives are consistent with standards and guidelines for RNAs and SIAs in the forest and grassland plans.

Recreation

Analysis Method

No significant issues related to these resources were identified during public scoping. However, the MBRTB identified the potential effects of invasive plant treatment on recreation users as a concern.

The recreation aspects evaluated were loss of opportunity as measured by persons at one time (PAOT) days and visitor satisfaction. PAOT days are objective measures of the quantity of opportunities; visitor satisfaction is a measure of the quality of opportunities. Loss of opportunity can also be measured by a change in the recreation opportunity spectrum (ROS); however ROS is not a meaningful metric for this analysis since none of the alternatives would change ROS classes on the MBRTB.

Persons at one time (PAOT) is a common measure of recreation capacity most often used at developed areas; however, PAOTs may also be estimated for dispersed use areas. PAOT days are calculated by multiplying the PAOT capacity of a site by the operating season. A reduction in PAOT days represents a reduction in supply; however, the practical impact of such a reduction may be tempered because few sites operate at maximum capacity. Visitor satisfaction is generally characterized as the difference between a visitor’s expectations and experiences. It is used as a surrogate for recreation quality.

Affected Environment

The MBRTB’s ability to meet a growing demand for recreation is being undermined by factors that are reducing the range, nature, and quality of existing recreation opportunities. Recreation opportunities on the two forests are already limited by a short season. Added to that are impacts to popular recreation sites from the regional bark beetle epidemic and recreation facilities that are not being adequately maintained or are being closed. The net effect is that developed recreation supply is limited or even declining while demand increases.

According to surveys conducted in 2007 and 2008, about 2.7 million recreation visits are made to the MBRTB each year (USDA Forest Service, no date). The MBRTB maintains hundreds of recreation sites with varying levels of development, from remote trailheads to developed campgrounds. PAOT-days capacity is about 1,800,000 (this is a measure of total annual capacity).

Surveys conducted in 2007 and 2008 indicate that most MBRTB visitors are satisfied with the recreation services and facilities they encounter. However, satisfaction tends to be lower at developed areas and lowest at campgrounds where visitors expressed some dissatisfaction with the condition and cleanliness of facilities and the availability of information, among other items (USDA Forest Service, no date). These measures of satisfaction could be much different now due to widespread changes from the mountain pine beetle epidemic.

Environmental Effects

The primary mechanism by which invasive plant treatment could affect recreation users is loss of opportunity due to area/trail/road closures or warnings according to chemical (herbicide) label directions or other safety protocols associated with treatment activities. Loss of opportunity could also result wherever invasive plants present a physical barrier or otherwise limit access or specific activities (e.g., thorny or bristly plants such as musk thistle or plants that obstruct waterways).

Invasive plant treatment could affect satisfaction if visitors are exposed to odors, noise, or other evidence of treatment activities. Satisfaction could also be affected if invasive plants impede travel or cause discomfort or if they cause changes in the perceived environment

Alternative 1 (Current Management) – Direct and Indirect Effects

Ground-based, chemical treatments occurring at the same time and place that visitors are recreating could result in a short-term loss of recreation opportunity. Closures for chemical treatments would typically last less than 48 hours and might occur at a handful of sites each year. As an extreme example, if 25% of all the developed recreation sites on the MBRTB experienced a 48-hour closure for weed treatment every year, the result would be less than 1% reduction in PAOT days. ROS class and the percentage of acres assigned to each ROS class would not change. Both beneficial and adverse impacts would likely occur to visitor satisfaction: adverse impacts where visitors are directly exposed to treatment activities and beneficial impacts where treatments are effective in reducing or eliminating bothersome/nuisance plants.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

The effects of alternative 2 on recreation users would be similar to those described under alternative 1, except that more temporary closures could occur due to additional treatment acres. Any increase in closures and related impacts would be minimal.

The main target for additional treatment acres would be large areas where aerial application of herbicides is the most practical option. Aerial application would not be used in developed campgrounds, and dispersed recreation is most common near water-bodies and in forested areas where aerial application would likewise be restricted or not used.

Alternative 3 (No Aerial Application) – Direct and Indirect Effects

The effects of this alternative would be the same as those described for alternative 2. The absence of aerial spraying would not change the effects described above for this alternative because aerial spraying is expected to have minimal, if any, impact on recreation areas.

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

Compared to all the other alternatives, this alternative would have the least direct, adverse effects on recreation opportunities due to area closures. Some temporary closures could still occur if they are necessary to accomplish manual, mechanical, biological, or cultural treatments, but they would be limited to very small areas. Direct impacts to visitor satisfaction as a result of treatment activities would be reduced compared to the other alternatives. However, this alternative would have the greatest adverse impacts to satisfaction resulting from bothersome/nuisance plants.

Cumulative Effects

Ongoing and reasonably foreseeable actions were considered for the period 2008-2018. 2008 is generally recognized as the year the ongoing mountain pine beetle outbreak really took hold on the MBRTB, resulting in actions such as temporarily closing recreation sites and clearcutting campgrounds to remove dead and dying trees. 2018 is five years from now, which is the standard time period for work planning and consideration of future actions. It is also the year most actions described in the forest plan(s) are to be completed. The spatial bounds for the analysis include all lands administered by the MBRTB, as well as adjacent communities and regional population centers where changes in recreation supply and demand could affect use on the forest.

Cumulative impacts would be greatest under alternative 2 because of the greater possibility of short-term area closures for spraying. This effect, combined with the effects of the mountain pine beetle epidemic and reduced maintenance at facilities or their closure, has the greatest likelihood of reducing recreation opportunity and visitor satisfaction. Alternatives 1 and 3 would have similar cumulative effects but the effects would be less than under alternative 2 because aerial spraying of large areas is not part of these alternatives.

Alternative 4 would have the smallest cumulative effect on recreation opportunity and visitor satisfaction because closures would be limited to very small areas. However, this alternative could have a cumulative impact on visitor satisfaction when combined with mountain pine beetle epidemic effects and effects of reduced maintenance/facility closures if visitors are also inconvenienced by bothersome/nuisance plants.

Forest Plan Consistency

The four alternatives are consistent with standards and guideline for recreation in the forest and grassland plans.

Heritage Resources

Regulatory Framework

Under the terms of the 2009 programmatic agreement (PA) between the Wyoming SHPO and the MBRTB, application of pesticides that do not have the potential to affect access to or use of resources by Native Americans are exempt from further review and/or consultation. Forest managers, planners and heritage staff do not have to notify or consult with SHPO or other parties about these projects. Further, the PA exempts mowing treatment with a brush hog or similar rubber-tired equipment from review and/or consultation unless managers, planners, or heritage staff have reason to believe that a specific undertaking may affect historic properties. A letter was sent to the Colorado SHPO informing them of the project; no further compliance or concurrence is needed.

Analysis Method

The following assumptions were used in assessing the environmental effects of treating invasive plants:

- Cultural resources are managed according to existing laws, regulations, and programmatic agreements to protect these resources.
- Adverse impacts to Native American traditional properties and uses can come from disturbances to plant communities used traditionally or disturbances to significant sites.
- Beneficial impacts include management actions or policies that result in preserving and restoring traditional plant species.

Adverse effects are defined as those which compromise the integrity of a resource and may affect its eligibility for inclusion in the National Register of Historic Places or which compromise the integrity of a sacred site or introduce visual or auditory elements that may jeopardize the use of the site for ceremonial purposes.

Affected Environment

Virtually all types of cultural sites are present on the MBRTB, and they represent at least 12,000 years of human history. Known prehistoric sites include hunting camps, trails, rock art, burial mounds, to name just a few. Historic period sites such as emigrant trails, homesteads, and railroad grades illustrate the westward movement; and conflicts between settlers and the Indians have left evidence in the form of battlegrounds and forts. Mining-related properties such as head gates, mining shafts, ghost towns, and patterned tailings tell the story of boom and bust mining towns, the search for gold, and relations between the miners. Lodges, resorts, and campgrounds document the evolution of the outdoor recreation movements of the late 19th and early 20th centuries. Depression-era structures built by the Civilian Conservation Corps, early FS guard stations, and lookout towers illustrate the federal land management era of the past century. Military history is also represented, with sites on the Pole Mountain unit dating back to the mid-1800s.

Environmental Effects

Direct, Indirect, and Cumulative Effects under all Alternatives

Direct and indirect effects: Management activities, including the manual and mechanical treatment of invasive plants, may directly affect cultural resources. Treatments that don't disturb the ground (biocontrol, hand or aerial herbicide application) would be implemented in a manner that did not affect cultural resources.

If invasive plant treatment moves existing vegetation back to native plant communities, it would likely be beneficial to any traditional cultural properties and sacred sites. Native plant communities would benefit site setting as well as potential Native American plant use of the lands. This would be more likely under alternatives 2 and 3 because of the option to treat larger areas under alternative 2 and the option to use newer, more selective, more effective herbicides under alternatives 2 and 3. Alternative 1 could achieve this result to a lesser degree, and alternative 4 would be the least effective because of the limited treatment area and options.

Cumulative effects: Because all actions that involve ground-disturbing activity will be surveyed for historic properties and the standard for these projects is to avoid any adverse effects to significant historic properties, there should be no measurable cumulative effects to historic properties under any alternative.

Forest Plan Consistency

The four alternatives are consistent with the heritage resources standards and guidelines in the forest and grassland plans.

Social and Economic Aspects

Analysis Method

The analysis considered potential impact to adjacent landowners and other partners working to reduce or eliminate the occurrence and spread of noxious weeds and invasive plants in the analysis areas. No specific social and economic issues were highlighted during the scoping process. Potential effects to low income and minority populations were also assessed, as required by Executive Order 12898.

Data on acres treated for invasive plants on private, county, or other ownerships and their effectiveness or rate of reintroduction were not collected or not available for this analysis. A qualitative description of potential impacts was completed based on the assumption that other land owners would complete treatments similar to those on NFS lands. The analysis assumed treatments would continue on NFS lands and adjacent lands in the analysis areas for fifteen years.

Affected Environment

Three separate analysis areas were considered in the analysis: Routt, Medicine Bow (Med Bow), and Thunder Basin. Each area is made up of the counties that contain NFS lands as shown in the table below.

Table 26. Counties included in the three analysis areas.

Routt	Med Bow	Thunder Basin
Colorado	Wyoming	Wyoming
Garfield	Albany	Campbell
Grand	Carbon	Converse
Jackson	Converse	Crook
Moffat	Natrona	Niobrara
Rio Blanco	Platte	Weston
Routt		

The administrative boundaries of the Medicine Bow-Routt and Thunder Basin units include non-NFS lands (see following table). The Medicine Bow has about 22% of its total administrative boundary in acres owned by another ownership; the Routt has about 10% and the Thunder Basin nearly 70%. The mix of ownership is important because it affects the way invasive species are treated across the analysis area.

Table 27. National forest system acreage and other ownership with analysis area.

	National Forest System	Other Ownership	Total w/in NFS
Medicine Bow	1,096,906 acres	306,986 acres	1,403,892 acres
Routt	1,125,428 acres	121,938 acres	1,247,366 acres
Thunder Basin	553,290 acres	1,266,122 acres	1,819,409 acres

Source: USDA Forest Service, LAR 2012; MBRTB GIS layer.

Environmental justice: None of the analysis areas or the individual counties have much diversity and are unlikely to have minority populations. Some counties have higher poverty rates than either the state or analysis area averages: Jackson, Albany, Niobrara, and Weston. Jackson County in Colorado is the 4th least populated county in the state, with an economy centered on agricultural activities. Agricultural income reporting can often under report benefits to individuals which may inflate poverty rates. The University of Wyoming, Laramie Community College, and a branch of WyoTech are all located in Albany County. The Wyoming Women's Corrections Center is located in Niobrara County. The Wyoming Honor Conservation Center and Boot Camp is located in Weston County. These institutions likely have higher poverty rates due to the student or incarcerated populations included during the census counts. These four counties with higher poverty rates are unlikely to see disproportionately high and adverse impacts from any of the alternatives as the impacts would likely be the same for all residents and visitors.

Environmental Effects

Alternative 1 (Current Management) – Direct and Indirect Effects

It is unlikely that the spread of noxious weeds across the MBRTB would be controlled under alternative 1 because of the limited number of acres that would be treated annually and the limited range of treatment options available. Weeds would likely spread onto adjacent non NFS lands.

The economic impacts of this invasive species spread could be reduced forage for livestock and wildlife, lower land values, and an inability to participate in or maintain effective weed control partnerships with adjacent landowners. Adjacent communities in the analysis areas could see an economic impact of the invasive species since these communities rely, to varying degrees, on the resources available on the MBRTB. Lack of an effective treatment option for cheatgrass would limit partnership opportunities to treat that invasive species on the Thunder Basin National Grassland where the majority of the mixed ownership occurs.

Alternative 2 (Preferred Alternative) – Direct and Indirect Effects

The more effective treatment options in alternative 2 would reduce the economic impacts of invasive species and allow improvement in the quantity and quality of native vegetation. This would maintain or increase the value of the land and resources in the analysis area. Weeds would spread onto fewer adjacent and intermingled private and state acres.

Economic impacts would occur where noxious and invasive plants begin to die off and native plant populations begin to recover. In some areas, soil conditions may require additional, short-term expenditure to prevent or reduce erosion-related impacts and to hasten the restoration of native plants, where appropriate. These impacts should decrease as native plant populations recover.

The MBRTB would continue to build partnerships with federal, state, and county agencies and cooperators such as grazing associations and oil and gas companies as part of an integrated invasive species and noxious weed treatment program.

Alternative 3 (No Aerial Application) – Direct and Indirect Effects

This alternative would have smaller beneficial economic effects than alternative 2 because it does not include aerial spraying for cheatgrass. It would still limit the spread of invasive species, improve native vegetation, and maintain the value of the land and resources to a limited degree. However, lack of an effective treatment option for cheatgrass would limit partnership opportunities to treat that invasive species on the Thunder Basin National Grassland where the majority of the mixed ownership occurs.

Alternative 4 (No Herbicide Use) – Direct and Indirect Effects

Impacts to areas surrounding the MBRTB are likely to be more extensive because treatment options and acres to be treated are limited under this alternative. Invasive species spread would continue to lower land and resource values on adjacent and intermingled state and private lands. Alternative 4 does not encourage partnerships to control invasive species, particularly those aimed at treating cheatgrass.

Cumulative Effects

The past, present, and reasonably foreseeable future actions considered in this cumulative effects analysis were decreasing land values and decreasing livestock market values in the analysis area. Existing invasive species infestations and their potential spread can further reduce land values and can reduce available forage making it more expensive to run domestic livestock. Habitat for sage-grouse and other sagebrush-dependent species could be reduced or locally eliminated. Crucial big game winter ranges, especially for mule deer, could experience increased infestations of cheatgrass, and huntable populations could be reduced. This decrease of goods and services from the natural environment impacts the economic well-being of the rural areas and communities in the analysis area, and the economic stability of these areas becomes strained.

Adverse cumulative effects under alternative 2 would be less than the other alternatives. With more acres treated and more treatment options, communities in the analysis areas would see little economic impact from invasive species. Grazing, wildlife habitat, ecosystem function, and recreational opportunities would continue to benefit the economic well-being of rural communities. This would help offset the existing effects of decreasing land and livestock market values. Adjacent landowners and managers and county, state, and other federal agencies providing cooperative weed treatment support would have greater success with treatments on their lands because MBRTB would be more likely to match or exceed adjacent landowner programs.

Adverse cumulative effects would be greatest under alternative 4. Rural areas and communities would experience economic impacts as the effects of limited invasive species treatment (less available livestock forage and reduced land and resource values) combine with existing decreases in land and livestock market values. Sagebrush communities could become heavily infested by cheatgrass, negatively affecting habitat for several sagebrush obligate species, including sage-grouse. Crucial big game ranges could similarly be affected; huntable populations of mule deer, bighorn sheep, and even pronghorn could be reduced, with resultant economic hunting losses to several Wyoming and Colorado counties and municipalities.

Adverse cumulative effects from alternatives 3 and 1 would fall between those described above. Cumulative effects from alternative 3 would be less than those from alternative 1 when combined with the effects of decreasing land and livestock market values in the analysis area.

Forest Plan Consistency

There are no forest or grassland plan standards and guidelines specific to social and economic resources. The plans contain goals for contributing to the economic viability of local governments and communities (Routt plan) and for delivering technical and community assistance and supporting ecological, economic, and social sustainability (Medicine Bow and Thunder Basin plans). The four alternatives meet these long-term goals.

Climate Change

Rising CO_2 levels, increasing surface temperature and the likely instability of weather and precipitation patterns have the potential to increase the spread of invasive species (Ziska et al. 2010). Alternatives 4 and 1 would limit the MBRTB's ability to effectively treat invasive species. Alternatives 3 and 2 would provide more treatment options and allow treatment of new invasive species. This would improve the MBRTB's ability to manage climate-change-induced invasive species spread. Alternative 2 would add the option of treating large infestations (particularly cheatgrass) with aerial herbicide application.

There is no way to quantify increases or decreases in CO_2 between alternative 2 which treats the maximum acres of invasive species and alternative 4 which treats the minimum.

Forest plan consistency: There is no forest plan direction specific to climate change. The standards and guidelines for biological diversity (Medicine Bow and Routt plans) and biological resources (Thunder Basin plan) may serve as surrogates for some aspects of climate change, and the four alternatives are consistent with this direction.

Other Resources in the Project Area

The IDT evaluated the following resources and determined there were no effects from the alternatives. None of the resources listed was identified as an issue during scoping or a concern by the IDT. Reports for these resources are available in the project record.

Table 28. Project area resources that were not included in the EIS.

Resource	Summary of Potential Effects
Livestock grazing	There is potential for effects to human and livestock health and to soil, water, and native vegetation from herbicide use under alternatives 1, 2, and 3. However, herbicides must be applied as specified on their labels and in accordance with the resource protection measures in appendix A. This substantially reduces the risk of adverse effects to humans and other organisms. The four alternatives are consistent with livestock use, range, and livestock grazing standards and guidelines in the forest and grassland plans.

Resource	Summary of Potential Effects
Fire and fuels	Invasive plant species can affect fuel type and fuel loading and continuity. Cheatgrass increases the frequency with which areas burn. With more frequent fires, native shrubs and perennial grasses cannot recover and a cheatgrass monoculture can develop. This monoculture further increases the frequency of fires and increases the dominance of cheatgrass in the area. Cheatgrass could colonize areas that would normally be bare ground, adding to the fuel continuity and increasing the fire hazard for adjacent private lands and infrastructure. Alternative 2 is consistent with standards and guidelines for fire, fire suppression, fuels treatments, and prescribed fire in the forest and grassland plans. Alternative 4 would not be consistent with the following guideline and alternatives 1 and 3 would not be consistent in most, if not all, areas where there are cheatgrass infestations: Fuel treatment guideline 4 grasslandwide direction (TB) and guideline 2 forestwide direction (MB): Reduce the threat of wildfire to public and private developments by following guidelines in the National Fire Protection Association Publication 299, Protection of Life and Property from Wildfire, and reduce the fuel load to acceptable levels.
Minerals and special uses	Failure to effectively treat invasive species on the MBRTB can make it more difficult for minerals and special uses permit holders to meet weed treatment terms and conditions in their permits. Alternative 2 (preferred alternative) would minimize this impact to permit holders; alternative 4 would make it more difficult to meet permit terms and conditions for weed control. The four alternatives are consistent with standards and guidelines for mineral and energy resources in the forest and grassland plans.
Roadless areas	The MBRTB assessed impacts to roadless areas and submitted the roadless project evaluation form to the regional office per regional office direction. For all MBRTB roadless areas, consistency with the 2001 roadless area conservation rule and the Colorado roadless rule was determined and impacts to the nine roadless area characteristics were analyzed. The project is consistent with both roadless rules and impacts are summarized below: More information is available in the project record. **1. High quality or undisturbed soil, water and air.** Impacts to soil and water will be mitigated by following state and federal regulatory standards and herbicide label restrictions and implementing protection measures in appendix A. Any impacts to air quality will be short-term. **2. Sources of public drinking water.** The project would have an immeasurable effect on sources of public drinking water. The proposed treatments will be implemented by following state and federal regulatory standards and herbicide label restrictions and by using the protection measures in appendix A.

Resource	Summary of Potential Effects
Roadless areas, cont.	**3. Diversity of plant and animal communities.** Plant and animal communities are expected to benefit from invasive species treatment through improved habitat diversity. Treatment implementation could temporarily relocate some animals; however they would likely return following treatment. There is the possibility of plant damage from herbicide drift. This would be mitigated by implementing protection measures in appendix A. **4. Habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land.** Treatments are not expected to impact species dependent on large undisturbed areas because most treatments would be small and localized. In the case of aerial spraying for cheatgrass, habitat has already been impacted by the conversion from native vegetation to a cheatgrass monoculture. Habitat for Preble's meadow jumping mouse (threatened species) could be impacted by prescribed burning or drift from herbicide application. Appendix A has a resource protection measure for this species, as well as protection measures for other TES species. **5. Primitive, semi-primitive motorized, and semi-primitive non-motorized classes of dispersed recreation.** Prescribed fire and mechanical treatment could impact ROS classes. However, the impacts would be temporary and the subsequent increase in plant diversity and vigor would have a positive effect on ROS. **6. Reference landscapes.** Research Natural Areas or areas identified as reference landscapes may be included for treatment; reduction of invasive plant species will assist in maintaining these reference landscapes. Canada thistle has been found in the Kettle Lakes and Mad Creek RNAs, and the establishment record for each recommends that infestations should be treated as soon as possible to prevent expansion. Roadless areas would maintain the characteristics of unmanaged, reference landscapes. **7. Natural-appearing landscapes with high scenic quality.** Mechanical treatment, herbicide spraying, and prescribed burning would slightly diminish natural appearing landscapes with high scenic quality in the short-term but would enhance the landscape in the long-term through the eradication of invasive plant species. **8. Traditional cultural properties (TCPs) and sacred sites.** TCPs and sacred sites will be protected through project design. All actions that involve ground-disturbing activity will be surveyed for historic properties, and the standard for these projects is to avoid any adverse effects to significant historic properties. Treatment of invasive plants would likely be beneficial to any TCP and sacred sites because it moves existing vegetation back to native plant communities. **9. Other locally identified unique characteristics.** No other locally unique characteristics to the roadless areas were found.

Short-term Uses and Long-term Productivity

NEPA requires consideration of "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

Alternatives 1, 2, 3, and 4 may result in the short-term loss of non-target species and localized biodiversity in areas where herbicides, some mechanical treatment, and fire treatment methods are used. Grazing and some mechanical treatments may affect non-target species through temporary loss of biomass but these plants are generally not killed by these types of treatment actions. Biological agents are host-specific and do not have an effect on non-target species. In this analysis, the overall the long-term effect of all identified noxious weed treatments is increased biodiversity and restoration of the natural productivity through the eradication of invasive plants.

Alternatives 1, 3, and 4 may result in losses of native plant communities, biodiversity, forage production, and wildlife habitat due to the anticipated continued spread of noxious weed species, particularly cheatgrass. Greater sage-grouse and other sage-dependent wildlife species may be affected by this loss of habitat.

Unavoidable Adverse Effects

Under alternatives 1, 3, and 4, loss of native plant communities is a potential unavoidable adverse impact. Since these three alternatives do not have measures to effectively control the existing 97,000 acres of cheatgrass on the MBRTB, the loss of native plant communities could easily exceed 100,000 acres.

Herbicide treatments proposed in alternatives 1, 2, and 3 could have some unavoidable environmental impacts. Adverse effects would primarily involve localized, short-term impacts to non-target plants. Although it is possible that small amounts of herbicide could migrate from treatment sites, the resource protection measures in appendix A would prevent environmentally significant concentrations of herbicide from reaching surface or groundwater. Following herbicide label instructions and implementing protection measures in appendix A would protect applicators and the public from unacceptable exposure to herbicides and threats to human health.

Manual, mechanical, biological, and cultural treatments under all the alternatives have no known unavoidable adverse effects. Thus under reasonably foreseeable circumstances, there would be no significant environmental effects.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. There would be no irreversible commitment of resources under any alternative.

Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

Under alternatives 4, 1, and 3, the expected continued expansion of noxious weeds, particularly cheatgrass, could irretrievably reduce or eliminate existing plant diversity and associated resource values, including overall ecosystem function.

Alternatives 2, 3, and 1 may result in some short-term irretrievable commitments of resources because some non-target species of vegetation could be affected by herbicide use in the short-term. These commitments would be localized and would not have significant effects on biodiversity, wildlife habitat, or forage production.

There would be no irretrievable commitment of resources involving threatened, endangered, proposed, or sensitive wildlife species or other wildlife species of concern from implementing any alternative. Impacts from actions would be short-term. No long-term loss of plant species is predicted from herbicide applications, and native forb species reduced by herbicide applications are expected to recover within a few years after treatment and thrive after reduction from weed competition. Under the alternatives 4, 1, and 3, weed infestations would continue to intensify and spread, grass and forb cover would be reduced, and wildlife would be indirectly impacted. The longer weeds are allowed to propagate, the longer it may take to recover plant and animal communities after treatment is undertaken.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with …other environmental review laws and executive orders.” The MBRTB consulted with the following agencies to ensure compliance with other laws:

- Wyoming State Historic Preservation Office (SHPO) and the Colorado SHPO to ensure compliance with the National Historic Preservation Act of 1966, as amended in 1999.
- U.S. Fish and Wildlife Service in accordance with the Endangered Species Act implementing regulations for projects with threatened or endangered species.
- Environmental Protection Agency in accordance with the National Environmental Policy Act , 42 U.S.C. 4231, Council on Environmental Quality (CEQ) regulations 40 CFR parts 1500-1508, and section 309 of the Clean Air Act (CAA).

Executive Order 12898, issued in 1994, ordered federal agencies to identify and address the issues of environmental justice (i.e., adverse human health and environmental effects of agency programs that disproportionately impact minority and low income populations). Environmental justice was evaluated and disclosed in the *Social and Economic Aspects* section. The four counties with higher poverty rates are unlikely to see disproportionately high and adverse impacts from any of the alternatives as the impacts would likely be the same for all residents and visitors.

All alternatives are consistent with Environmental Protection Agency, Occupational Health and Safety Administration, state and federal water and air quality regulations, and Forest Service regulations (FSM 2080) regarding pesticide use and worker safety.

Chapter 4. Consultation and Coordination

Preparers and Contributors

Table 29. Forest Service interdisciplinary team (IDT) members participating in compilation of the final environmental impact statement.

Name	Position Title	Function
Misty Hays	Deputy District Ranger, Douglas	Project lead
Melissa Dressen	Wildlife biologist, RNF	Primary IDT
Cristi Painter	Wildlife biologist, TBNG	Primary IDT
Steve Loose	Wildlife biologist, MBNF	IDT support
Wendy Haas	Range specialist; MBNF	Primary IDT
Katherine Haynes	Botanist; MBNF and TBNG	Primary IDT
Kolleen Kralik	Heritage program manager	Primary IDT
Greg Eaglin	Aquatic program lead, MBRTB	Primary IDT
Cynthia Englebert	Botanist, TEAMS	IDT support, project record
Melissa Martin	Planning director; MBRTB	Reviewer
Kelle Reynolds	Renewable resources director, MBRTB	Reviewer
Hal Pearce	Regional noxious weed coordinator	Reviewer
Chris Wehrli	Regional Environmental Coordinator - Roadless Coordinator	Reviewer

Federal, State, and Local Agencies

During scoping, we met with and/or sent letters to the following local, state, and federal government agencies explaining this project and asking for input. They also received copies of the DEIS.

Table 30. Local, state, and federal agencies consulted.

Local government agencies	
Carbon County Commissioners	Rawlins, WY
Natrona County Commissioners	Casper, WY
Town of Dixon	Dixon, WY
Town of Encampment	Encampment, WY
Town of Saratoga	Saratoga, WY
Converse County Conservation District	Douglas, WY
Little Snake River Conservation District	Baggs, WY
Laramie Rivers Conservation District	Laramie, WY
Saratoga Encampment Rawlins Conservation District	Saratoga, WY
Laramie Rivers Conservation District	Laramie, WY
Campbell County Weed and Pest	Gillette, WY

Crook County Weed and Pest	Sundance, WY
Board of Land Commissioners	Craig, CO
City of Steamboat	Steamboat Springs, CO
Colorado State Forest Service	Steamboat Springs, CO
Colorado State Parks	Denver, CO
Craig City Council	Craig, CO
Grand County Commissioners	Hot Sulphur Springs, CO
Jackson County Commissioners	Walden, CO
Moffat County Commissioners	Craig, CO
Routt County Commissioners	Steamboat Springs, CO
Routt County CU Extension Office	Steamboat Springs, CO
Routt County Historic Preservation	Steamboat Springs, CO
Routt County Planning Commission	Steamboat Springs, CO
Grand County Division of Natural Resources	Granby, CO
Steamboat Lake State Park	Clark, CO
Town of Craig	Craig, CO
Town of Walden	Walden, CO
North Park Conservation District	Walden, CO
State entities	
Wyoming Department of Agriculture	Cheyenne, WY
Wyoming Department of Environmental Quality	Cheyenne, WY
Governor’s Planning Office	Cheyenne, WY
State Lands & Investments	Cheyenne, WY
Wyoming Game and Fish Department	Cheyenne, Laramie, Baggs, WY
Wyoming State Forestry	Cheyenne, WY
Wyoming State Parks and Cultural Resources	Cheyenne, WY
Colorado Department of Natural Resources	Craig, CO
Colorado Division of Water Resources	Denver, CO
Colorado Division of Wildlife	Steamboat Springs, Meeker, Craig, Glenwood Springs, Hot Sulphur Springs, CO
State Forest state park	Walden, CO
Congressional delegates	
U.S. Senator John Barrasso	Rock Springs, WY
U.S. Senator Mike Enzi	Gillette, WY
U.S. Representative Cynthia Lummis	Cheyenne, WY
U.S. Senator Mark Udall	Washington, DC
U.S. Senator Michael Bennet	Washington, DC
U.S. Representative John Salazar	Washington, DC

Federal agencies	
U.S. Fish and Wildlife	Grand Junction, CO and Cheyenne WY
U.S. Natural Resources Conservation Service	Laramie, Gillette, Newcastle, Saratoga and Wheatland, WY
U.S. Bureau of Land Management	Craig and Kremmling, CO; Rawlins, WY
EPA Region 8 (Larry Svoboda)	Denver, CO

Tribes

We sent letters to the following tribes, explaining this project and asking for input. No responses were received. Copies of the DEIS were also sent to these tribes.

Table 31. Tribes consulted.

Eastern Shoshone Tribe	Fort Washakie, WY
Northern Arapaho Tribe	Fort Washakie and Arapaho, WY
Southern Ute Tribe	Ignacio, CO
Ute Mountain Ute Tribe	Towaoc, CO
Crow Tribe of Indians	Crow Agency, MT
Fort Peck Assiniboine and Sioux Tribe	Poplar, MT
Northern Cheyenne Commission	Lame Deer, MT
United Tribes of Colorado	Taos, NM
Cheyenne and Arapaho Tribes	Concho and Watonga, OK
Cheyenne River Sioux Tribe	Eagle Butte, SD
Lower Brule Sioux Tribe	Lower Brule, SD
Northern Ute Tribe	Fort Duchesne, UT

Organizations, Businesses, Individuals

The organizations, businesses and individuals listed below commented on the project during scoping.

Table 32. List of scoping commentors.

Continental Divide Trail Society	Forest Guardians	Rocky Mountain Chapter of the Sierra Club
Colorado Wild Inc.	Colorado Historical Society	Timberline Trailriders Inc
Jackson County Water Conservancy District	North Park Chamber of Commerce	
Wyoming Wilderness Association	Biodiversity Conservation Alliance	Wyoming Outdoor Council
Wyoming State Board of Outfitters	Motorized Recreation of WY	Thunder Basin Resource Coalition
Inyan Cara Grazing Association	Thunder Basin Grazing Association	Platt Guides and Outfitters

BKS Environmental Assoc, Inc.	Budd-Falen Law Offices LLC	
Jean Public	Wendell Funk	Roz McClellan
Lowell Wade	Lydia Garvey	Richard Artley
Jean Harshbarger	Cynthia Patterson	John Ziegman
Caryl Schonburn	Keith Wilhoit	Sharp and Barney Llc.
James Berggren	Casey Colbert	Pem and Deborah Eberlein
Jim Espy	Greg Gibson	Dennis Larratt
Peter Laybourn	Robert Melin	Greg Pope
Jimmie Porter	James Rittmueller	John Spezia
John Thomas	Mike Troast	George and Val Vohs
Donald Wagoner	Marilyn Werner	Alberta Carlson
Helen Bailey	Mike Stanopiewicz	John Winkel
Troy Adkins		

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